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POSSIBLE IMPACT ON AGRICULTURE OF THE EXPLOSION OF THE SOVIET NUCLEAR PLANT AT CHERNOBYL

M-213 COMPLETED 63

HEARING

BEFORE THE

COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY UNITED STATES SENATE

NINETY-NINTH CONGRESS

SECOND SESSION

MAY 15, 1986

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POSSIBLE IMPACT ON AGRICULTURE OF THE EXPLOSION OF THE SOVIET NUCLEAR PLANT AT CHERNOBYL

THURSDAY, MAY 15, 1986

U.S. SENATE,
COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY,
Washington, DC.

The committee met, pursuant to notice, at 11:23 a.m., in room SR-332, Russell Senate Office Building, Hon. Jesse Helms (chairman of the committee) presiding.

Present: Senators Helms, Boschwitz, Andrews, and Melcher.

STATEMENT OF HON. JESSE HELMS, A U.S. SENATOR FROM NORTH CAROLINA

The CHAIRMAN. The committee will come to order, and I will ask that the doors be closed as quickly as possible. I am really not a billygoat gruff, but we have got to proceed here; 2 or 3 days after the accident at the Soviet nuclear facility at Chernobyl, I called the staff in, and told them to begin work on ascertaining as much as could be known about the effects of the nuclear fallout. I wanted to know the impact of that accident, of course, but I also wanted to know, to the extent possible, the potential impact of any similar accident—and all pray that there will not be another one anywhere—and I want to know the impact on agriculture, and that is the purpose of this hearing. I think we have got some interesting information which we will hear.

The witnesses include one of our distinguished colleagues, the Senator from South Dakota, Mr. Abdnor, who is chairman of the Joint Economic Committee of the Congress, and Jim and his committee conducted a hearing of this nature quite recently.

In addition we are going to have representatives from various agencies of the Government, and a specialist on agricultural markets from the private sector.

As the committee is obviously aware, the accident that occurred at the Chernobyl nuclear reactor site last month introduced an unexpected variable into the international agricultural situation, both in terms of a quantitative impact on supply and demand, and a potential, qualitative impact on agricultural commodities in the area subjected to unusually high levels of radiation.

Anticipation of increased Soviet food-import needs boosted corn and wheat futures prices by 9 and 14 percent, respectively, since the disaster began affecting the market in late April.

Analysts have preliminarily estimated that Soviet grain production this year may very well decline as much as 10 percent from earlier projections, as a result of the accident. The Soviet Union has already purchased 500,000 metric tons from the United States since the incident, prompting added speculation about the agricultural implications of the accident.

Effects have been felt on markets for fresh foods as well; 11 of the 12 members of the European Community have banned imports of fresh food products from Eastern Europe until at least the end of May.

And, of course, the major reason for the markets' uncertain and volatile reaction to Chernobyl has been the Soviets' failure to cooperate in providing information on the incident to the international community.

There was a stab at it yesterday, but many questions still remain. And we are not in a position, even yet, to insist on the Soviets full and prompt disclosure of the details of the accident.

However, through various methods, the information curtain is being opened bit by bit to obtain important information on the impact of this incident. The further dissemination of this information is the major purpose of this hearing.

Now, Sheldon Meyers, Director of Radiation Programs for the Environmental Protection Agency will represent the task force established by the administration to investigate the Chernobyl accident. Then Dr. Robert Thompson, Assistant Agriculture Secretary for Economics, along with several technical experts, will present testimony on historical agricultural production and other information relating to the affected area.

In addition to assessing the effect of this particular accident on agriculture, we are also going to hear testimony regarding the prospects for the future, similar accidents—and we pray again that there will be no more, but if they occur we want to know what the reason is and what effects they could have.

For this reason, testimony will be presented on the purpose of the Chernobyl nuclear reactor and similar graphite reactors in the Soviet Union, whether for producing civilian electricity or high-grade nuclear weapons, or both; and whether the purpose of the nuclear reactor in question affects the nature of the danger of nuclear accidents to the environment, and therefore, agricultural production.

Delbert Bunch, who is Acting Deputy Assistant Secretary for Reactor Development in the Department of Energy, and Victor Stello, Executive Director for Operations of the Nuclear Regulatory Commission will present testimony in those areas.

Let me place in the appendix the statements of Senators who could not be here this morning.

Now, before proceeding further, I want Ron Phillips of the agriculture staff to describe to the committee some visual aids that have been prepared to illustrate the geographic distribution of crop and livestock production in the Europe-Asia region, and the radioactive fallout from the Chernobyl accident.

Now, our expert witnesses will testify in detail on these matters, so let me suggest to the members of the committee, that we with-

hold technical questions regarding the maps until the respective testimony of the various witnesses.

All right, Ron.

Mr. PHILLIPS. Thank you, Mr. Chairman. What we have tried to do is take some general commodity production information and put it in a visual setting, so that we can get a better understanding of what some of the potential effects of the fallout are.

The maps, and the data that was used from USDA to make this visual aid, are in a packet in front of each of the members. What we have done is take the western half of the Soviet Union, the area where the predominance of the nuclear powerplants are in the Soviet Union, as well as Western Europe, and on this basic map here, on our first map, these red dots represent the location of the Soviet nuclear powerplants.

Chernobyl is designated here, and for reference purposes, Moscow is up here. On our first overlay, it will show the radiation spread of the explosion at Chernobyl. The horizontal lines are the—or I should say the vertical lines, the vertical red lines are the initial spread of radiation during the first couple of days after the accident.

Later, the wind pattern shifted and the horizontal lines show the later spread, later in the week. Then just for reference purposes, we have shown some of the major commodity production in the area.

This map shows the production of both corn and wheat, wheat represented by the orange dots and corn represented by the green dots.

Then some of the major meat production is shown on the last overlay. Swine and cattle production; cattle production designated by the darker blue dots and the swine production by the light blue dots.

The CHAIRMAN. How recent is that spread? What does that represent?

Mr. PHILLIPS. The spread of the radiation shown here by these red lines was only within the first 4 or 5 days after the accident.

The CHAIRMAN. All right. Let me inquire of Senator Boschwitz, do you have an opening statement?

Senator BOSCHWITZ. No.

The CHAIRMAN. Senator Andrews.

STATEMENT OF HON. MARK ANDREWS, A U.S. SENATOR FROM NORTH DAKOTA

Senator ANDREWS. I have a very brief one, Mr. Chairman. I think you have put together a good hearing, but the problem that I am getting into in this is that here we have a disaster, a nuclear disaster that affects people well outside the Soviet Union.

Our Scandinavian friends are concerned about fallout and the impact on their dairy products. People in the Eastern European Community that is tied to the Soviet Union are beginning to wonder about how much they can trust their "big brother bear" in this whole thing.

We have been called upon to ship such supplies as milk powder and the rest, because this type of fallout, as I understand, on the grass concentrate in the milk, and it is particularly a problem.

But here again, we are seeing a total rerun of what happened in the famine in Ethiopia. The response was that United States planes ended up flying in Canadian wheat in the great gesture to help the starving Ethiopians.

Now here we have got a situation where the Eastern Europeans are not all that happy about the Soviets, for a lot of reasons. They are concerned about their children, and our response is to get all bogged down in who we are going to let distribute the milk in Poland, or wherever else.

I would hope, Mr. Chairman, that we could continue these hearings, but instead of the witnesses we get, I would like to see some administration witnesses that can testify to why, when an opportunity to use our food as a positive weapon for peace, and better understanding in a troubled world comes about, we can always find those bureaucrats downtown who gum up the works. Republican bureaucrats gumming up the works do not appeal to me, any more than the Democratic bureaucrats that gum up the works. We have had a lot of that in the past.

I would like to find out why we seem to, invariably, goof up an opportunity like this. I would hope, Mr. Chairman, we could get some of those people that could give us a response as to why we get totally bound up with idiotic rules and regulations that keep us from being responsive to people who might want to shift our way, might say: "Hey, you know, you're doing pretty well by us, just because of some bureaucrat that exceeds his bounds."

So I would hope, Mr. Chairman, we could extend the hearings, which are well thought out——

The CHAIRMAN. As long as is necessary to get all of our questions answered, and I thank the Senator.

Senator Abdnor, we are glad to have you and appreciate your coming by, and appreciate your patience. We are not but 39 minutes late, which is almost a record for this committee, but, you may proceed, sir.

STATEMENT OF HON. JAMES ABDNOR, A U.S. SENATOR FROM SOUTH DAKOTA

Senator ABDNOR. Thank you, Mr. Chairman. Senator Boschwitz, Senator Andrews. I would wait a long time to have a chance to say a few words on this subject, and I know you expedite your hearings as quickly as humanly possible to get the kind of answers you want.

I just want to thank you for holding today's hearing on the nuclear accident at Chernobyl, and as you said in your opening statement, I did hold a hearing in the Joint Economic Committee about 10 days ago to gather information concerning the agricultural implications of the most serious nuclear accident that the world has yet experienced.

I am just pleased as can be to see you doing this hearing today, and as Senator Andrews said, probably continuing it and going into the full depth of all of the ramifications of this situation, how it

affects the United States, and particularly the world and those people affected.

Now I know you have got some very expert witnesses, and Senator Boschwitz asked me if I considered myself an expert witness. I said yes, but I really do not, so I will be very brief.

We have included some of our witness statements that we received at our May 5 hearing of the Joint Economic Committee and have turned them over to your staff, and so I am not going to bother dwelling on that. But I will say that our confidence in nuclear energy technology has suffered greatly over the last 2 weeks.

The accident at Chernobyl apparently was only a partial meltdown of one reactor, we are told, and we may never know how close the Russians were to experiencing a complete meltdown on all four reactors at Chernobyl. Had that happened, would we multiply the consequences of death, injury to food supplies, and the resources contaminated by 8 times, or 16 times, or whatever it might be? We do not know, and, we need to know.

My point, Mr. Chairman, is that our response to the Chernobyl disaster should be in proportion to the worst-case scenario, and on this basis I would just propose four suggestions. I have been thinking about this for quite a while, and for what they are worth, I would like to propose some thoughts to you on what we might do.

I think first, we should establish an independent international study team of agricultural radiation ecologists to learn all we can about the impact of this nuclear accident on the soil, crops, and animal life.

Now I know that means in cooperation with the Russians. Hopefully, what we heard yesterday was just the start of them starting to loosen up and let us in on this.

Not to take full advantage of this opportunity would be foolish, and this of course would require the cooperation of the Soviet Government. This cooperation must be secured by the rest of the world.

This is an opportunity for the Soviet Government to demonstrate that it is a responsible world citizen. Second, I think that we ought to have a world network to effectively identify and contain contaminated food products, and this must be created immediately.

Some countries such as Western European countries have imposed total import bans on all food products originating in potentially contaminated areas.

Other countries, like the United States, have apparently only taken random samples of food imports. As a consumer, I am fearful that some of these foods, blocked from entering some countries, may find their way into less protected Third World countries, or even on the U.S. supermarket shelves.

I understand that the Food and Drug Administration has already passed mushrooms from Italy and salmon from Scandinavia, which were detected to contain a so-called harmless dose of contamination, through United States Customs.

Frankly, if I cannot get those products stopped at our borders, I want them at least identified as to their countries of origin. As American consumers, I think we are fortunate to have alternatives, and of course the best of which are American mushrooms and American salmon. But I think there should be some kind of label-

ing on products coming in, the country it comes from, when it was grown, and if there is any contamination at all in it, they should so state it on the label.

Third, this scare should revitalize serious consideration of a world security stockpile, food supplies strategically located throughout the world and internationally financed.

The world today has but 2 months' supply of cereal grain, and one-half of that supply is right here in the United States.

It is clearly in the interest of those major grain-importing countries to purchase and maintain their own security stockpile.

The United States cannot and should not attempt to hold our supplies, singlehandedly. Our farmers know well the disastrous price effects of stockpiles of grain. Perhaps international financial assistance can be provided to those countries highly dependent on food imports, but unable to afford the purchase and maintenance of security foodstocks.

I need not tell you or your committee that it is costing us something like $400 million a year as taxpayers for the grain in storage, and we are really doing it for the other countries of the world who should very well be a part of this.

Finally, we need to analyze our own nuclear-power industry and policy relative to the American production in agriculture. The U.S. Nuclear Regulatory Commission has stated that the United States will suffer a Chernobyl-type accident some time within the next 50 years. I hope to heaven that never happens.

This is not a comforting thought, though, to us, and especially not to our children and grandchildren. We have been forewarned that the responsibility to prepare rests on our shoulders.

In conclusion, Mr. Chairman, we must not view and treat the Chernobyl as just another isolated topical event in world history, a here-today-gone-tomorrow event. I am convinced somebody is trying to tell us something, and I think we had better listen, and I thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much, Senator. I know you agree that Senator Andrews raised a very relevant question and we will certainly get into it, and I will say that experience with Communist dictatorships indicates no compassion whatsoever for their own people.

In the case of Ethiopia, the evidence is abundant, in so many ways, that they do not care about their people, and, well, you look at the forced migration. The government takes charge of whatever is sent there, and that sort of thing, and they dole it out to their own political philosophy, the people who agree with it. The Polish Government is not better.

And so I must say that I commend and understand—while I am not unsympathetic with what Senator Andrews has said, I do have great sympathy for the notion that we ought to know what we will be doing in terms of the ultimate and eventual recipients of the grain.

But thank you very much, Senator.

Senator ABDNOR. One last thing. I wonder now if the situation might not be just a bit different with people, even our own people, wanting to know more, and now starting to wonder. You know, thinking is the best thing you can do——

The CHAIRMAN. I agree.

Senator ABDNOR [continuing]. And you never know what this may lead to without questioning the governments of these other countries.

The CHAIRMAN. Correct.

Senator ABDNOR. When you start threatening people's children they get concerned.

The CHAIRMAN. No question about it, but on the other hand, these people have got nothing to resist with; no question.

Senator ABDNOR. That is right.

The CHAIRMAN. And so, all of that gets into the mix.

Senator ABDNOR. Thank you. I want to say one thing, you have one great witness I can speak for, Mr. Urbanchuk. I am glad you brought him here today. I can tell you, he will do a fine job in testifying.

The CHAIRMAN. Thank you very much. We will be glad to have you stay, if you wish.

Senator ABDNOR. I would like to.

The CHAIRMAN. All right. On our second panel are representatives of the Environmental Protection Agency and the USDA, and appearing as I said earlier, for EPA, is Sheldon Meyers, who is Acting Director of the Office of Radiation programs, and I will ask these gentlemen to come up and take their seats.

The EPA, as I indicated earlier, is the lead agency of the President's Task Force on the Chernobyl Accident. Mr. Meyers will provide us with some information and background on the accident, and the work of the administration's task force, and will also discuss the environmental impact of the accident.

Appearing for the USDA, a familiar face, Bob Thompson, Assistant Secretary for Economics. Dr. Thompson will provide us with information regarding historical production in affected regions, traditional weather patterns, and the effects on agriculture of nuclear contamination.

Accompanying Dr. Thompson I believe are a number of experts who will be available to answer any technical questions that the committee may wish to propound.

You may proceed, sir. Thank you very much for your cooperation and for being here, and for your patience. You may proceed.

STATEMENT OF HON. SHELDON MEYERS, ACTING DIRECTOR, OFFICE OF RADIATION PROGRAMS, ENVIRONMENTAL PROTECTION AGENCY

Mr. MEYERS. Thank you, and good morning, Mr. Chairman, and members of the committee. My name is Sheldon Meyers. I am the Acting Director of EPA's Office of Radiation Programs. Lee Thomas, Administrator of the U.S. Environmental Protection Agency, has asked me to appear today on his behalf, to present to you information on the Soviet nuclear reactor accident at Chernobyl.

I have been asked to give you an overview of the President's Interagency Task Force on the Soviet nuclear accident and the Federal response to this accident. I will also describe for you the

monitoring and sample analysis that is ongoing for air, water, and milk by the EPA.

First, the task force and the Federal response. President Reagan set up an Interagency Task Force on April 29, 1986. Lee Thomas, EPA's Administrator, was named to head the task force, which has met daily, except for this past Tuesday, May 13, since its first meeting on April 30, 1986.

I should say that at the meeting yesterday, Mr. Thomas announced that unless something unforeseen comes up, he does not plan to hold further regular meetings. If there is a reason for holding them, he will

The task force consists of representatives from 15 departments and agencies.

The primary roles of the task force are to coordinate the collection of all available information, analyze the data, and then coordinate the Federal response and the dissemination of the information to the public.

The result of this effort has been very effective to date; key agency contacts have been designated to respond to specific types of public inquiries and a daily task force report on the Soviet nuclear accident is issued by EPA.

We expect to continue issuing that daily report for probably another couple of weeks.

Now the work of the task force has been accomplished through several work groups that have been set up. There is a health and agricultural work group that is headed by the FDA; a data collection and dose assessment task group headed by EPA; an atmospheric task group headed by the National Oceanographic and Atmospheric Administration; a reactor scenario group that is headed by the NRC; and finally, a public information group that is headed by EPA.

Let me now give you some background information on EPA's Environmental Radiation Ambient Monitoring System, otherwise called ERAMS. This environmental monitoring system has been in place since 1973, when several separate but related radiation monitoring networks were combined.

The ERAMS collection and anlysis of environmental samples constitutes the Nation's single major continuous source of environmental radiation data acquisition and analysis. It is a cooperative program between the States and local governments, which collect the samples, and the EPA, which performs the analyses using verified analytical and quality assurance procedures.

ERAMS consists of 268 sampling locations which routinely collect environmental data on air particulates, precipitation, milk, drinking water, and surface water. The air particulate and drinking water stations take samples representative of about 39 percent of the American population while the milk sampling stations cover over 40 percent of the milk consumed by U.S. citizens. The sampling networks are in all 50 States, the Panama Canal, and also one other location, Puerto Rico. Radiation analysis are performed on ERAMS samples and include gross alpha and gross beta levels, gamma analyses for fission products and specific analyses for uranium, plutonium, strontium, iodine, radium, krypton, and tritium.

Special consideration is given to certain radionuclides, such as gross beta in air particulates, for screening or early warning procedures, and iodine, cesium, and strontium, because one would expect to find them in fallout of fresh fission products, such as those emitted from the Soviet nuclear reactor accident.

Each of these radionuclides also has biological significance. Iodine is concentrated in the thyroid: cesium in lean flesh; and strontium in bone. These radionuclides are also readily passed through cows into the milk supply.

Typical ambient levels of radioactive iodine in air and milk are near zero due to its short half life—which is about 8 days—and resulting decay. Cesium and strontium persist in the environment for a longer period of time due to their longer half lives, about 2 years for cesium and about 29 years for strontium.

As an example of detectable amounts of fallout above normal background levels in the daily national air sampling networks, the iodine-131 concentrations have ranged from 0.0002 picocuries per cubic meter to 1.6 picocuries per cubic meter. These levels are considered very low and do not pose any danger to health or the environment.

The daily precipitation—that is, rainwater samples, recently reported show a number of cities with detectable levels of iodine-131 resulting from the nuclear reactor accident at Chernobyl.

The highest deposition level reported was 12,300 picocuries per square meter.

The CHAIRMAN. What is a picocurie?

Mr. MEYERS. A curie is a way you measure radiation. A picocurie is a trillionth of a curie. And I should say a curie itself represents 37 billion disintegrations per second.

The CHAIRMAN. I see.

Mr. MEYERS. It is a way you measure concentrations of radioactive material in air or water or on the ground.

As a frame of reference, the U.S. Food and Drug Administration has a Protective Action Guide for deposition of iodine-131, which would cause public health officials to take action to withhold food products from the market, and that level is 130,000 picocuries per square meter.

Thus, the 12,300 level represents less than 10 percent of the FDA guide and is not considered to pose any threat to health or welfare. The information we have been receiving from foreign countries is somewhat sketchy, and we have not been able to validate it for accuracy. Therefore, at this time, we are not able to determine either the immediate effects or project the long-term effects on agriculture or agricultural products.

I will defer to the Department of Agriculture and the FDA for more specific information on the Chernobyl accident as it relates to agricultural products. I have a copy of the date that was collected, which I can leave here for the committee.

The CHAIRMAN. Very good.

Mr. MEYERS. As I mentioned before, the Federal Government is working together to analyze all the available data on the Soviet accident and we would be pleased to share those with the committee and any of our future findings.

This concludes my formal statement, Senator.

The CHAIRMAN. Thank you very much. It is a fine statement and I will understand it better after I get my dictionary out. But Bob, thank you for coming, and you may proceed.

STATEMENT OF HON. ROBERT L. THOMPSON, ASSISTANT SECRETARY FOR ECONOMICS, U.S. DEPARTMENT OF AGRICULTURE, ACCOMPANIED BY DR. JAMES R. DONALD, CHAIRMAN, WORLD AGRICULTURAL OUTLOOK BOARD; DR. NORTON STROMMEN, CHIEF METEOROLOGIST, WORLD AGRICULTURAL OUTLOOK BOARD; KATHRYN ZEIMETZ, SOVIET ANALYST, ECONOMIC RESEARCH SERVICE; KEITH SEVERIN, AGRICULTURAL ECONOMIST, FOREIGN AGRICULTURAL SERVICE; DR. MARY CARTER, ASSOCIATE ADMINISTRATOR, AGRICULTURAL RESEARCH SERVICE; AND DR. LESTER CRAWFORD, ASSOCIATE ADMINISTRATOR, FOOD SAFETY INSPECTION SERVICE

Dr. THOMPSON. Thank you, Mr. Chairman. It is a real pleasure to be back with the Senate Agriculture Committee.[1] I am pleased to appear before you today to discuss the potential impact of the Chernobyl accident on agriculture.

With me are several witnesses who will assist in responding to your questions. They include Dr. James R. Donald, Chairman of the USDA's World Agricultural Outlook Board; Dr. Mary Carter, Associate Administrator of USDA's Agricultural Research Service.

The CHAIRMAN. Let me ask the people to stand up as they are presented.

Dr. THOMPSON. James Donald. Mary Carter.

The CHAIRMAN. Good.

Dr. THOMPSON. Also, Dr. Les Crawford, Associate Administrator of USDA's Food Safety and Inspection Service, who has served as our representative on the White House Task Force on the Chernobyl accident; and Dr. Norton Strommen, USDA's Chief Meteorologist.

In addition, available to provide other technical expertise and support are Keith Severin of the Foreign Production Estimates Division of the Foreign Agricultural Service; and Kathryn Zeimetz, the Chief of the Eastern Europe and Soviet Branch of USDA's Economic Research Service. Biographies of these individuals were submitted for the record.

From the start, Mr. Chairman, let me say that I share this committee's concerns about all ramifications of the Chernobyl accident and world agriculture. However, at the outset, I must emphasize that what we do not know far exceeds what we do know.

Information from the U.S.S.R. concerning any aspect of the accident has been limited, and I would caution, that until we know what hit the ground and the water, assessment will be impossible.

As you know, within the U.S. Government, a well-functioning and orderly process was immediately established by President Reagan to deal with all areas of concern. The White House task force, headed by the EPA, has been a central point to which we have all turned. However, for the task force as a whole, or its

[1] See p. 39 for the prepared statement of Mr. Thompson.

member parts, such as USDA, speculation never can be substituted for information that simply is not yet available.

Those of us involved in agriculture have a further responsibility to avoid disruption to markets rocked initially by conjecture about impacts of Chernobyl. Thus, as I address this committee today, I must remind you of the factual void facing us and hope that the members here today will be patient if some of our responses begin, "We simply do not know." Hopefully, in time, we will know these answers and we will have the privilege of sharing them with this body.

Although information on agriculture in the region around the reactor is limited, it is adequate to provide estimates of normal levels of production. Some technical information is available on the impacts of varying levels of radioactive contamination. We also know what the Soviet weather patterns were at the time of the Chernobyl accident, and these data can be used to identify areas potentially exposed to contamination.

However, there is little information available on the nature and extent of actual contamination on crops, on livestock, and on the surface of the ground. Lacking this, assessment is only tentative at best.

As the world now knows, beginning at 1:23 a.m., April 26, Kiev time, a series of events occurred at the Chernobyl nuclear facility near Kiev in the Soviet Union, leading to a fire, explosion, and core meltdown.

The explosion and fire released a plume of radioactive materials into the air. Air mixing at the vicinity of the accident site caused fallout to be transported both by winds at the surface and at upper levels of the atmosphere. The radioactive plume traveled northwest and then west toward East European and Scandinavian countries, and has since dispersed widely throughout the Northern Hemisphere. The Chernobyl plant is in the extreme northern Ukraine, north of Kiev.

Weather conditions since the accident suggest areas immediately around the site were exposed to surface contamination, while a larger area, mostly to the north, was exposed to windborne contamination. A brief description of daily weather conditions since the accident follows.

On April 26, surface winds blew toward the northwest over areas of Belorussia, the Baltic States and Northeast Poland, all minor grain-producing areas. Showers and thunderstorms were reported in the area of the plant.

On April 27, the airflow moved toward western Belorussia and Poland. On April 30, gentle surface winds shifted very briefly toward more important grain-producing areas of the northern Ukraine and the Black Soils region.

On May 1, wind speeds increased and reversed direction, heading toward the western Ukraine into Southeastern Europe. By day's end, radiation release reportedly was significantly contained, thus reducing windborne radiation after this date.

From May 2 to 5, the winds shifted toward the southeast and slowed by May 6. On May 7 and 8, widespread showers fell over Chernobyl and in other parts of the region.

On May 9, light rain continued over the Ukraine, and from the Urals eastward into the New Lands. Early this week, scattered light showers fell and winds continued light and variable around Chernobyl.

Agricultural production, both crop and livestock, can be affected by exposure to contaminants, by measures taken to avoid exposure as well as by decontamination measures.

The nature of radiation's effects depends on many variables, such as the type of isotopes present, dosage, stage of crop growth, crop canopy, and soil type and quality.

Other considerations in this complex equation include rainfall and the topography of the land, and drainage or runoff from the field. These elements can adversely affect water quality for humans, animals, and irrigated agriculture. Short-lasting isotopes, such as iodine-131 and barium-140, dissipate in a matter of days, whereas radiation from the long-lasting isotopes, such as cesium-137 and strontium-90, remain after decades.

Sheltering and washing agricultural materials are measures used to deal with immediate exposure effects to both types of isotopes. Additional measures include keeping animals from contaminated pastures for days to weeks, and storing contaminated agricultural products for an appropriate period to allow for dissipation of radiation.

The effects of long lasting isotopes are much more difficult to assess and counteract. In extreme cases, abandonment of affected areas for up to decades could be required. It is unclear at present, however, whether such restriction will be applied by the Soviets to any of its agricultural land.

The Chernobyl powerplant is located in the extreme northern Ukraine in the Western U.S.S.R. about 8 miles from the Belorussia border. The Soviets report that people were evacuated from a zone 18 miles around the plant. There are conflicting reports, however, regarding livestock slaughter versus evacuation in the 18-mile zone.

The Soviet media contains a number of reports about normal agricultural operations in the general area outside this ring, but little hard information exists concerning quarantine procedures for milk or fresh vegetables.

It is important to emphasize, that at this time there is no information—no information whatsoever—to support theories that agriculture in most of the Ukraine and Belorussia have suffered or will suffer from significant radiation damage. The area close to Chernobyl is not important agriculturally.

To help put this area and its productivity in perspective, it may help to consider the oblasts in the area. An oblast is an administrative subdivision of a republic. Sizable parts of four oblasts lie within a 100-mile radius of Chernobyl. These four account for only 4 percent of Soviet agricultural output, 3 percent of the Soviet grain output, 4 to 5 percent of its meat and milk production, and about 10 percent of Soviet sugar beet production.

The Baltics and Belorussia, areas believed under the initial plume, produce on average about 5 percent of Soviet grain, 20 percent of the potatoes, 10 percent of the meat, and 15 percent of the milk produced in the U.S.S.R. Areas to the southwest of the plant,

also subject to windborne contamination, produce an estimated 5 percent of the grains, 10 to 15 percent of the potatoes, 5 to 10 percent of the meat and milk and over a quarter of the sugar beets produced in the U.S.S.R.

Mr. Chairman, the remainder of my written statement deals with factors that we feel affected the Soviet response to the accident, the potential effect on agriculture in Eastern Europe, how countries there have responded to the incident, and the potential implications for the United States food system.

In the interest of time, with your permission, I will not read the remainder of my formal testimony but would like to submit it for the record, and will be delighted to answer any questions to the best of my ability, or to the ability of our staff members with me. Thank you very much.

The CHAIRMAN. Thank you very much. I have read the entire statement and it is most enlightening. Let me ask you a few questions, first, of you, sir. The Soviets have reported they evacuated an 18 or 19 mile radius of the facility. Is that right?

Mr. MEYERS. Yes, within 30 kilometers; that is about 18 miles.

The CHAIRMAN. What is the level of contamination within that area? That 18 to 19 miles?

Mr. MEYERS. Senator, we do not know, exactly, but we have been getting information from the Soviets on that. They have said something on the order of 250 to 300 R per hour, right in the immediate area of the plant itself. That was several days ago and it is probably decayed somewhat; but for your information, a dose of about 300 to 500 R, total, is lethal to half the people that get it, in 30 days.

So, in the immediate area of the plant, within about a mile or two, I believe the Soviets have said that is what the level there is. We have not been able to verify that.

The CHAIRMAN. Let's move it out, just to give me an idea—let's say out to 50 miles. What would be the level of contamination close to a 50-mile radius?

Mr. MEYERS. That is difficult to say because of the manner in which the incident took place.

The CHAIRMAN. It would be speculative.

Mr. MEYERS. We think what happened was, when the explosion took place, it blew much of the radioactivity past certain areas, and obviously, as it goes out, it disperses. Our original analysis indicated that within about 2 to 3 miles there were lethal doses, and that out to about 10 miles there were the kinds of doses that would give you a severe case of radiation illness, not necessarily lethal. Beyond that, we did not speculate because we would have to have known what the concentrations of radionuclides were in the release, and right now, the only way to estimate that, is from measurements that we have taken in the various countries in Europe, and calculating back from that.

The CHAIRMAN. You know, a Senator is never supposed to admit that he does not know everything, but this Senator does not. I was reading in the paper about the bone marrow transplants. How do they do that? They did nine, I believe, yesterday, or something like that.

Mr. MEYERS. One of the severe effects of close-in, high levels of radiation, destroys the bone marrow itself which is involved in the process of producing blood cells. If you get that kind of dose of radiation, one way to try to arrest it is to remove the damaged marrow and replace it with fresh marrow.

The CHAIRMAN. So it is localized then?

Mr. MEYERS. Well, in the bone marrow. There are other things you would need to do. For example, isolating the individual so that his immune system has a chance to rejuvenate. These would have been people who are in very close proximity to the plant, or outside of it.

The CHAIRMAN. Yes. Bob, we have to make assumptions, and that is the best we can do on the levels of contamination. What do you anticipate—and of course I am asking you to speculate, I know, and that is not really fair—but what do you believe is going to be the effect on livestock and plants, and soil, within that 19-mile, or 50-mile, or 100-mile area? I think that is what we are getting at.

Dr. THOMPSON. Mr. Chairman, beyond that close-in 18-mile radius, where we do expect there is likely to be contamination that severely, adversely affects agriculture, but beyond that 18-mile radius, we simply have no evidence whatsoever even to speculate.

The problem is that we do not have any on the ground measurements of what actually hit the surface of the ground and the crop canopy closer than Sweden, and because of that, it really would be irresponsible to speculate——

The CHAIRMAN. Yes, I guess it would.

Dr. THOMPSON [continuing]. Because you know how extremely sensitive this kind of speculation would be on the markets, and we would have no basis for inferring anything about what happened outside that 18-mile radius.

The CHAIRMAN. All right. Let me put it another way. Let's assume that there is a—and you two have got to get together about the appropriate level of speculative contamination, and I just want a hypothesis. How long would the Soviets have to leave fallow those areas where there is a certain degree of contamination?

Dr. THOMPSON. Could I ask Dr. Mary Carter from the Agriculture Research Service to address that specific question?

The CHAIRMAN. Sure.

Dr. CARTER. Mr. Chairman, it would depend on the types of isotopes released, whether cesium, strontium, or whatever. It will depend on the quality of the soil, and there are many variables there. It also would depend on the intensity of the radiation from those isotopes, as to how long it would have to stay fallow.

If you are talking in terms of some strontium, for example, you will find that that is interchangeable with calcium, frequently, and if the soil has a high clay content, you will have one type of problem; if it is cesium, you have another type of problem; and it also depends on the rainfall in that area, as to how long it would be there, and just how you would handle it.

The CHAIRMAN. Thank you, ma'am.

Mr. MEYERS. Senator, one point that I think is important to make—you have noticed, we have all been talking about a desire not to conjecture. It was one of the main features of the task force.

The information we put out, daily, was factual information, and where we did not know something we said we did not know it.

We tried very hard not to conjecture on various scenarios and you just heard Dr. Carter describe a number of reasons why it would be foolhardy to do so. There are so many variables and without taking measurements, on the ground, of what isotopes actually hit, what their concentrations were, and what the permeability of the ground is, what crops they were growing—anybody could guess and you could come up with 10 different scenarios, and none of them may be right; all of them may be right. I think it would be misleading for the U.S. Government to make projections like that and the task force judiciously avoided it.

The CHAIRMAN. Well, the same would be true with livestock. You could not pinpoint. Well, reference was made to the weather patterns. If it was the usual weather pattern—one of you correct me if I am wrong—it would spread to the east; but in this case it spread first to the north, is that correct?

Mr. MEYERS. Northwest.

The CHAIRMAN. Then to the west. Maybe it would be a good idea for you, or one of your people to come up and operate on this map, so I can get it a little bit clearer in my mind as to what happened, in terms of the weather, and the shift, and the drift.

Dr. THOMPSON. This is Dr. Norton Strommen, who is our chief meteorologist in the Department, and who monitored it on a daily basis.

Dr. STROMMEN. The normal weather patterns for the month of April, result in the highest frequency of blocking—and when I say blocking, I simply mean high pressure building in the Eastern Atlantic, in this area.

This would have a tendency to divert most storms north, and storms would come into the Soviet Union from the north, and then south-eastward. Another storm track would develop across the Mediterranean and move through the Mediterranean into the southern parts of Russia.

This area would be dominated by high pressure, the predominant winds would be northwest across the Chernobyl area. They would still have southeast winds in this area.

So that you have a dividing line there in terms of the prevailing winds. At the time of the plant explosion, what we had was a pattern where you had support for winds from the high-pressure area located in this area, and you had a southeasterly flow in this direction across the plant. This took the initial plume to the northwest. You also had a storm system out over the Atlantic here, in the seas off Great Britain, so part of this plume would have come north and then would have turned south, and come back around that storm system.

The other part would turn and go toward the east, and out over the Arctic and come back down on this side of Russia. So, if they had had their prevailing winds, then you would have seen a flow with this plume coming primarily down in this direction. As it was at the time of the accident, you clearly had a northwesterly plume from the plant. This is where you would expect the strongest concentration to occur.

The CHAIRMAN. John, you interrupt any time you have a question. Is this unique, for the weather patterns to shift like that?

Dr. STROMMEN. Spring is a season of great variability because it is a period of changing storm systems, and so each time a storm system comes through, you get a complete change in pattern.

At this time that primary storm pattern was for the storms to develop in the Atlantic, move up over the Scandinavian countries, and then come south over Russia, southeastward. And the second one was the storm systems moving through the Mediterranean and coming up this way, and indeed, that is exactly what we were seeing.

The CHAIRMAN. Thank you. Do you have an overlay here, Ron, relating to the Soviet reactors? Now the red dots.

Dr. STROMMEN. The red dots are the Soviet nuclear plants.

The CHAIRMAN. I guess what I am asking, did the weather patterns have anything to do with the location of those?

Dr. STROMMEN. I am sure that the Soviets have looked at the prevailing winds, but I am sure that is not a final factor in locating, but this is really beyond my area of expertise. I really do not know how they arrived at that conclusion.

The CHAIRMAN. But it is interesting to see where they are located, keeping in mind your pointing out the shift of the weather conditions. Well, thank you very much.

Bob, we are sort of at the mercy of news reports and such information as we have heard from the Soviet Union, including the address yesterday. But I keep hearing about policies restricting the use of certain agricultural products, and so forth.

Is the Soviet Union doing very much of that, or, do you know?

Dr. THOMPSON. We simply do not have any information whatsoever on what they have done with respect to their own food supply.

The CHAIRMAN. So you could only speculate, and as you indicated, that would not be very reliable, as to what is going to occur in terms of the shortages in some of the markets. Or have you got any measurement of that?

Dr. THOMPSON. No, we do not. I would only reiterate, Mr. Chairman, the point that we made in the testimony, that the Chernobyl area itself is not an important agricultural region of the country. The large wheat belt to the southeast of Kiev, the heart of the Ukranian wheat belt, was not under the wind pattern at the time the plant was burning.

Fortunately for the Soviets, in terms of their grain supply, the wind was moving to the northwest, taking it in the other direction. But we simply do not know enough to infer anything.

The CHAIRMAN. Well, we do know about a very recent, since the accident, Soviet purchases, or proposed purchases of livestock, grains, and so forth, don't we? You have released some figures in that connection, haven't you?

Dr. THOMPSON. Well, the Soviets have been buying a significant amount of grain in the markets this year. We expect about 30 million tons, or a little more, and frankly, there has not been any perceptible change in their pattern since the accident from what was going on before.

The CHAIRMAN. What do they figure on buying, 190 million metric tons, or something like that?

Dr. THOMPSON. Of?

The CHAIRMAN. For the year.

Dr. THOMPSON. Of grain?

The CHAIRMAN. Yes.

Dr. THOMPSON. Well, we figure about 30 million tons of wheat, I believe. Isn't that right, Jim?

Mr. DONALD. About 30; production of about 190 million tons.

The CHAIRMAN. Yes, 190.

Dr. THOMPSON. 190 million tons of production; 30 million tons, imports.

The CHAIRMAN. All right. John. Senator Melcher, do you have any questions?

Senator MELCHER. I have one question. Has there been any attempt by the Department of Agriculture or our State Department, to determine whether Russia, Poland, or any of the adjoining countries might need some of the excess dairy cows we have, or the beef from those cows, when slaughtered?

Dr. THOMPSON. We have made offers in terms of humanitarian assistance. We have also certainly been very forthcoming, about being willing to sell surplus dairy cattle. Now there is one problem of course, in selling dairy cattle to the Soviets.

As you know, there are areas of the Soviet Union that are brucellosis free, so they do not vaccinate for brucellosis, and from what we understand, they will not buy cows which have been vaccinated against brucellosis.

Of course in this country, virtually every dairy cow is vaccinated against brucellosis, so that really limits any potential market for us, for live dairy cattle.

Senator MELCHER. That includes Poland and Czechoslovakia?

Dr. THOMPSON. I do not personally know about the veterinary requirements in those countries, but Les Crawford may be able to answer that question, from the FSIS.

Dr. CRAWFORD. I think that is correct, Senator Melcher, that all of them would have that problem. Now, about the meat, we do not know, but the Secretary made an offer about nonfat dry milk, as you know, and we have yet to have any takers in that respect.

Senator MELCHER. Was meat mentioned?

Dr. CRAWFORD. No, sir; not in that telegram.

Senator MELCHER. That included Poland?

Dr. CRAWFORD. Any affected country.

Dr. THOMPSON. Senator, following up on that question, you may have seen that yesterday, we announced the sale of about 198 million pounds of beef to Brazil, as a result of the Dairy Whole Herd Buy-Out Program, so we are moving aggressively to move more of that beef out of the commercial United States market, to do everything possible to minimize adverse effects in that beef market.

Senator MELCHER. No, I had not seen that announcement. I think generally speaking we get your announcements, but by the time we get them delivered they are generally a day or two late.

Dr. THOMPSON. It came out at the end of the afternoon. I think the contract was signed at 4 o'clock yesterday afternoon, for 198 million pounds of beef.

Senator MELCHER. Over what period of time?

Dr. THOMPSON. The coming year.

Senator MELCHER. One year?

Dr. THOMPSON. I believe that is correct.

Senator MELCHER. Thank you.

The CHAIRMAN. Well, thank you very much, gentlemen. More questions may occur to us, and if you do not mind, we will file them in writing.

Dr. THOMPSON. Of course. We will be glad to answer any for the record, sir.

[Written questions from Senator Leahy and Dr. Thompson's answers thereto:]

Question. What is the Department of Agriculture's estimate of the wheat crop loss because of the Chernobyl accident? I have heard estimates that range from no effect to as much as 10 percent crop loss.

Answer. The Department of Agriculture released the first forecast for the 1986 Soviet grain crop on May 9. The 190 million tons forecast included 80 million tons of wheat. The forecast did not include an adjustment for the effects of the Chernobyl accident because information on the nature and extent of contamination was not available.

This lack of information makes it impossible for the USDA to quantify the effects of the accident on Soviet agriculture. However, Soviet officials have indicated that no farm work was being done within 37 miles of the plant while the soil was being decontaminated. The area within a 37-mile radius accounts for less than .5 percent, possibly 500,000 tons, of the USSR's grain production.

The USSR published data on grain production by oblasts—administrative sub-divisions within republics until 1976. From this information, we can estimate normal grain production in a broader 125-mile radius of the reactor exposed to varying degrees of wind-born contamination. The plant is located in the extreme northern part of Kiev Oblast in the Ukraine. Two other oblasts, Gomel in Belorussia and Chernigov in the Ukraine, are within a dozen miles of the plant. Zhitomir Oblast in the Ukraine borders Kiev Oblast to the west. These four oblasts account for about 3 percent (6 million tons) of Soviet grain production and about 2-3 percent (1.5 to 2.5 million tons) of wheat output. It is unclear, however, if or how severely production within this broader region has been affected.

Question. Will the Soviet sugar crop be affected? Isn't most of the Soviet sugar crop hundreds of miles from Chernobyl?

Answer. The lack of information at this time on the type and extent of radiation contamination in the USSR prevents quantitative forecasts of the effects of the Chernobyl accident on Soviet agricultural production, including the output of sugar beets—the Soviets domestic sugar source.

The area where the accident occurred lies on the northern edge of Soviet sugar beet belt. Belorussia and the Baltics, the areas to the north of the accident site believed under the initial plume of contamination, normally produce an estimated 3-4 percent of Soviet sugar beets. The four oblasts that largely fall within a 125 mile radius of the accident cite are estimated to produce about 10 percent of Soviet sugar beets. The most recent Soviet report says that farm operations are not being done within a 37 mile radius of the plant, an area accounting for about 6 percent of the area within a 125 mile radius of the reactor.

Question. Some experts believe that the Soviet milk supply will be reduced because of the Chernobyl accident. Their assessment seems to be based on both the nature of milk production and the concentration of Soviet milk production in the Ukraine. Will there be a shortfall in Soviet milk production? If so, where will the USSR obtain dairy products? From the U.S.? From the European Community?

Answer. Interest has focused on the USSR milk supply because of the potential effects on infants, the most radiosensitive portion of the population, and the short time period between deposition of contamination and consumer use. Furthermore, Belorussia and the Baltics, one of the Soviet areas potentially exposed to windborn contaminants, normally produce about 10-15 percent of Soviet milk and forage and pastures are important feed sources in the areas.

The lack of information about the types and degree of contamination and the precautions being taken rules out a quantitative assessment of the impacts of the accident. However, the Soviet's have reported that milk would not be sold from the contaminated area for three months but that it would be processed and marketed as cheese and butter after it was tested and found safe. The area designated as contaminated is not specified. A later report said that no agricultural work was being

done within 37 miles of the reactor while the soil was being decontaminated. The four oblasts which largely lie within a 125 mile radius of the accident site normally produce an estimated 4-5 percent of Soviet milk.

We have seen no substantive reports relating to milk production outside of the "contaminated zone", milk consumption and availability in Kiev, Belorussia, the Baltics, or other areas of the USSR, or milk imports since the accident despite the fact that the accident occurred almost 3 weeks ago.

In 1985, the Soviets imported 90 million pounds of nonfat dry milk and about 440 million pounds of butter. World dairy stocks are at high levels. EC intervention stocks of nonfat dry milk are at 1.5 billion pounds and intervention stocks of butter stand at 2.5 billion pounds. EC prices are very low for dairy products; the EC has sold the USSR butter at 13-14 cents per pound, at the time that the world price was 47-52 cents per pound. Total U.S. commerical and government stocks of dairy products were over 13 billion pounds (milkfat basis) as of February 1, 1986.

The CHAIRMAN. Thank you very much Dr. Thomspon. Now for the third panel, if these good folks will come up, we will hear from the Department of Energy and the Nuclear Regulatory Commission.

From the Department of Energy, we will hear from Delbert Bunch, as I indicated earlier, and who is Acting Deputy Assistant Secretary for Reactor Development, and, from the NRC, we will hear from Victor Stello, Executive Director for Operations.

These witnesses will help us evaluate the potential for disasters at similar reactors throughout the Soviet Union, and we can go back to the map, which you will want to use for that.

In addition, they will tell us whether these reactors are used for military, or for civilian purposes, or both, and whether the use of these reactors makes any difference in the kind of, and in the degree of contamination which may result in accidents.

Mr. STELLO. Mr. Chairman, would you like me to go first?

The CHAIRMAN. Well, whatever.

Mr. STELLO. I think we both probably can contribute to the answer to those questions.

The CHAIRMAN. Good; good. If you will pull the mike a little closer to you.

STATEMENT OF VICTOR STELLO, EXECUTIVE DIRECTOR FOR OPERATIONS, NUCLEAR REGULATORY COMMISSION

Mr. STELLO. Mr. Chairman, what I propose to do is just summarize for you the kind of reactor, and in the process of summarizing, try to attempt to answer the questions you have raised, and if I do not, perhaps we can get to them.[1]

The reactor that was involved in the accident at Chernobyl is the RBMK-1000 designated unit. Those reactors are used only within the Soviet Union. They have other types of reactors they use to produce electricity, that they do build in other countries, but not this particular type that was involved in the accident.

The reactor is a graphite moderated reactor and it has roughly 1,700 tubes that contain fuel in a place within the graphite, and if necessary, we can go to some pictures to explain that, if the interest is there.

The type of reactor is one that evolved from reactors of the type that were used, and they can be used to produce plutonium.

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[1] See p. 44 for the prepared statement of Mr. Stello.

We do not have any information that suggests that these reactors were in fact being used for that purpose. They appeared to be reactors that are being used for producing electricity in base-loaded plants, and the four reactors seemed to be operating for that purpose. We do not have any information to say that they would also be used to produce plutonium, although they are of the type that certainly can be.

The reactor accident, in terms of the details of what happened, is very, very sketchy. We have very little information as to what caused the accident.

We have, over the past several weeks, gleaned from a variety of sources, a description, in some detail, of what that reactor looks like and what is different about that reactor versus the commercial light water reactors in the United States, and those differences are quite significant in terms of the design of that plant versus what we use in this country.

The status, as we know it, in terms of the accident, and consequences within the Soviet Union, we have been doing the best to obtain information in that regard, and prior to the comments made yesterday, when Gorbachev addressed the Soviet Union, we had information that there were 204 people hospitalized with symptoms of radiation sickness.

What we had was information that said all of those people who were so injured were either firefighters—and most of them were firefighters trying to fight the fire—and some of them people who were employees of the plant. Gorbachev yesterday indicated that that number was now 299. We do not know if the difference between those two numbers represents people from the public, from off-site, who were in fact exposed to radiation levels high enough to now exhibit symptoms. The immediate fatalities associated with the accident were a result of steam burns to one individual and falling debris killed another individual.

The actual measurements that we have in and around the facility are very few. We are aware of only one measurement in terms of an actual radiation level in and around the facility, and that I think Dr. Meyers suggested a number, which would indicate in the immediate building around the reactor, that the dose levels are now on the order of 200 or 300 R per hour. That is immediately within the building, not in its surrounding area.

We know that the levels in and around the buildings have to be substantially lower than that because we have information that says that the facility is being manned with about 150 people per shift.

These individuals are in and around the building; there is work going around, on the outside and in the building. We are aware that they have been making efforts through a tunnel that exists between units 3 and 4, to put concrete in a pool underneath the reactor core of the damaged reactor, which says that they have to have radiation levels in the building that are significantly and substantially lower than those levels, in order to accomplish that work. We also know that the remaining three units at that plant, the equipment has not been damaged as a result of the accident, and those units are in fact being cooled with the usual systems to do that,

from the control room, and there is no indication that there is any danger or hazard associated with the other three units.

It is reported that the accident in unit 4 is stabilized. There are indications, and just a period of time would suggest so, that with passing time, they will be able to accommodate dealing with the accident much easier, since the radiation levels clearly go down, and the material that is in there in fact should be cooling, which ought to make things simpler for them.

The effects of the accident—I have Dr. Congel here with me—we would explain to you how we attempted to understand the severity of the accident by measuring levels of radiation throughout a variety of countries, Sweden, and so forth.

The CHAIRMAN. Good.

Mr. STELLO. Sweden, Finland, Poland, and et cetera. We could give you that information, and then from that information you can get a notion of the levels of contamination and radiation measurements in those countries, and how we use that information to back-calculate the radiation levels in and around the Soviet Union.

All of that information, however, is subject to a lot of uncertainty because of the lack of specific information in terms of what happened in the accident, and the actual scenario. What is different about this accident, that makes it very, very difficult to predict actual radiation levels close in, is it has been reported that the initial release of radiation was accompanied by an awful lot of energy released during the fire and the explosion.

When you have an accident for which there is an awful lot of energy, then the fission products that are released during the accident can be carried fairly high into the atmosphere, and if they are carried very high, it allows them to move large distances.

If that is true, then the contamination levels in and around close, could in fact be relatively low. The contamination levels further from the facility being significantly higher than you would have calculated, had it been what we would call a ground level release.

Now until we have that kind of information it becomes extremely difficult to predict, close in to the facility, what the contamination levels might be.

If you wish, I will turn to Dr. Congel and he can explain the methods that we used and the measurements that we had, chronologically, with time in various countries, and how, from those, we projected, or you might want to hear a summary.

The CHAIRMAN. Before you do that, I want to inquire, did you see The Wall Street Journal story yesterday? I found it very interesting.

It noted the comments of various nuclear experts, including a former Soviet engineer who helped build a plant similar to Chernobyl. One of the quotes went as follows: "The Soviets decided in the midfifties to build graphite reactors that would produce electricity and plutonium for weapons at the same time." I have some interest in that, as a member of the Foreign Relations Committee as well.

I believe I am correct—and I am quoting—"Graphite reactors have a neutron spectrum that yields weapons-quality plutonium." Do you agree with that?

Mr. STELLO. Yes.

The CHAIRMAN. "The U.S., on the other hand, was promoting reactor designs that produced as little plutonium as possible." That is certainly true, isn't it? Now, John, that map up there shows, I believe, 20 graphite reactors, including the 4 at Chernobyl, and 4 more under construction.

Each of these churns out weapons-grade plutonium on a continuous basis, according to my understanding. It is also my understanding that a major hazard leading to this accident and one that could lead to possible similar disasters at other reactors in the Soviet Union, is the link between fission reactivity and temperature in these reactors. Am I correct about that?

Mr. STELLO. I think that that statement probably refers to the reactivity coefficients in the reactors.

The CHAIRMAN. Yes.

Mr. STELLO. That is another major significant difference between those graphite-moderated reactors and our light-water reactors in that the void coefficient is positive. Gorbachev said yesterday in his talk, that the accident was initiated by a power surge.

I would think it would be reasonable then to mean that the disturbance might have been caused as a result of that positive reactivity coefficient, to create a very large imbalance in power generation in the reactor, that could have caused the accident.

I am inferring the power surge was caused by a reactivity transit—it would fit with my understanding. In simple terms, what that means is, in U.S. reactors, if you have, for any reason, a loss of water in the reactor, that the power in the reactor immediately decreases. In contrast, when they lose the water in the reactor with a positive coefficient, the power increases.

The CHAIRMAN. I am trying to understand this as best I can. When the temperature of the reactor goes up, the fission activity, you say, increases, right?

Mr. STELLO. Let me try to explain it, the relationship with power in a reactor. Normally, you have control rods in the reactor, and these control rods are in essence a "poison." That is, they cause fewer neutrons to exist. So, as you remove more and more control rods, then you allow more and more power to be generated. That is the principal mechanism for controlling the reactor with control rods.

They also can control the reactor by adding boron in the water and that is typically the way they do it in pressurized water reactors.

In the reactor in Chernobyl, the control mechanism was control rods, as I described earlier, that is moving control rods in and out. As you pull those control rods out, there is an increase in the fission process, hence, an increase in the power, and hence, generally an increase then in the temperature.

The CHAIRMAN. So they feed on each other and sort of produce a time bomb, in a way, don't they?

Mr. STELLO. Well, not with the control rods. Those are usually well understand, well manipulated, well controlled. The thing that makes it unusual or can create the problem for you is when you have a positive reactivity coefficient. We do not know that that was in fact what happened, or is it correct to say that that is the cause, except the first clue, it may be a reactivity induced transient. I

gleaned from the comments that were made yesterday, with an indication of a power surge. That is an attribute that does not exist in our reactor designs.

The CHAIRMAN. That is the point I was going to make.

Mr. STELLO. Yes.

The CHAIRMAN. Right. The Wall Street Journal pointed out the contrast between Chernobyl and the Western nuclear powerplants. The "Journal" says it "reveals a stark lack of concern by the Soviets for safety, health, and the environment," and according to the newspaper that tells us more about the Soviets than about nuclear power.

I think it would be good to have this article included in the record at this point.

[The article referred to by Senator Helms follows:]

[Reprint from the Wall Street Journal, May 14, 1986]

CHERNOBYL'S SPECIAL PROBLEM

The Soviets say that "a turning point" has been reached at the Chernobyl nuclear plant and the reactor core is being cooled down, thus reducing the risk that it might burn its way through the floor and contaminate ground water. Soviet officials say some 92,000 people were evacuated but only six have died so far; another 35 are in "grave condition." Efforts are being made to seal the reactor with concrete forever and clean up radioactive contamination in the vicinity. If these reports are accurate, the Soviets have had a bad accident but, as they claim, have averted a catastrophe.

How much worse the accident could have been will be debated endlessly in the West, and, unless the Soviets make a full and honest report, the debate will continue to be based partly on speculation. But some of America's leading experts on nuclear reactors are drawing conclusions that offer a great deal of comfort to those people outside of the Soviet bloc who have nuclear-power plants as neighbors. The central conclusion is that Soviet reactors are inherently far more dangerous than those in the West, for a simple reason: Soviet nuclear-power and nuclear-weapons programs are intertwined—safety has been sacrificed in the interest of turning out large quantities of weapons-grade plutonium.

Ever since the accident came to light more than two weeks ago, Western scientists have been vexed by some disturbing questions. Why, for instance, does the Soviet Union rely so heavily on graphite moderated reactors, which are so little used in the West? Why weren't Soviet safeguards sufficient to stop a meltdown? Why don't these Soviet reactors have containment systems?

According to nuclear experts at Ebasco Services Inc.—one of them a former Soviet engineer who helped build plants similar to the ones at Chernobyl—the Soviets decided in the mid-1950s to build graphite reactors that would produce electricity and plutonium for weapons at the same time. Graphite reactors have a neutron spectrum that yields weapons-quality plutonium. The U.S., on the other hand, was promoting reactor designs that produced as little plutonium as possible, to minimize the tricky problem of storing reactor wastes and to make it harder for foreign purchasers of U.S. power reactors to use them to build weapons. U.S. weapons-grade plutonium is manufactured at special, government-operated facilities that do use graphite reactors.

The Soviets have 20 graphite reactors—including the four at Chernobyl—and four more under construction. Each of these turns out large amounts of plutonium on a continuous basis. U.S. scientists and engineers theorize that the initial explosion at Chernobyl was caused by hot spots—which tend to develop in the huge pile of graphite blocks used to moderate the nuclear reaction—burning through water pipes and creating explosive hydrogen gas. When the hydrogen blew, coolant was lost and the reactor's temperature climbed out of control.

The experts say these Soviet reactors work on a principle called "positive temperature co-efficient reactivity." This means that as the temperature of the reactor rises, the fission activity increases; that in turn raises the reactor's heat, and so on. This design, which shocks safety-conscious Western scientists, is said to maximize plutonium output. By contrast, Western reactors work on precisely the opposite and safer principle—namely, as a reactor's temperature rises, fission slows and finally stops.

Moreover, the Soviet reactors are built for on-line, continuous fuel recycling. A machine is always working to remove and replace the fuel rods in the reactor's 1,700 channels, thus providing constant plutonium output. Because continuous recycling requires constant access, the Soviet design makes impractical the thick concrete containment vessels of the type used on Western reactors to contain radioactivity in case of an accident. Most Western reactors have to be shut down regularly to remove spent fuel. The Chernobyl explosion simply blew the roof off the building.

Aside from far stronger containment, Western reactors pose less danger of a runaway. This doesn't mean they can be operated carelessly. It only means that the dangers of emitting radioactivity are far less.

Despite its far greater safety, U.S. nuclear-power expansion has been pretty much stalled by anti-nuke litigants and associated financial risks. But it seems unlikely that Chernobyl will halt nuclear-power expansion in nations short on fossil fuels. For one thing, new designs are even safer. As the Journal's Jerry E. Bishop reported May 2, the Argonne National Laboratory, with the Energy Department, has built a new type of reactor that appears to be meltdown-proof. Even when scientists deliberately tried to cause an accident in a test reactor, it just shut itself down.

The contrast between Chernobyl and Western nuclear power-plants reveals a stark lack of concern by the Soviets for safety, health and the environment. Military demands, as always, took precedence. But as we've said before, that tells us more about the Soviets than about nuclear power.

The CHAIRMAN. Now I apologize for delaying you, sir, and you may proceed.

STATEMENT OF DR. DELBERT BUNCH, ACTING DEPUTY ASSISTANT SECRETARY FOR REACTOR DEVELOPMENT, U.S. DEPARTMENT OF ENERGY

Dr. BUNCH. What I would like to do is just give you a very brief factual setting of the nuclear power industry in the Soviet Union.

First, as of the start of this year, the Soviets have about 28,000 megawatt electric capacity. Now that compares to about 83,000 to 85,000 in this country.

Nuclear power generates about 10 percent of the electricity in the Soviet Union right now. In France, for example, it is about 65 percent. It is about 16 percent in this country.

The Soviets have a very ambitious power expansion program relying very heavily on nuclear power. I will read a few facts to you.

The data I have is as of the end of 1984. There were 13 operating graphite-cooled light-water reactors of the general type at Chernobyl. Four units at Chernobyl plus nine at other locations.

There were nine others under construction. There is a total of 22 reactors of this type either on-line or under construction.

The Soviets have another mainline development activity; that is to say, they have another kind of reactor that they are using. They call that unit a VVER. It comes in two sizes. They have 10 operating 400-megawatt class pressurized water reactors. The information on those is sketchy. From what I understand, those are not contained. They do not have the kind of safety systems that you would find in U.S. plants, but I do not have good details on that.

The Soviets' more recent nuclear programs are, in addition to these Chernobyl-like plants, are what are called the VVER-1000's. They have three 1,000-megawatt electric plants that are pressurized water reactors. They have containments and a number of safety systems in them.

They have another 28 of those units under construction. So these two broad classes of plants constitute the mainline of the Soviet nuclear expansion program.

Their most recent product lines seem to have included some additional safety systems. As Mr. Stello was pointing out, the evidence that we have from the Soviets is that they are attempting to put concrete in below the reactor vessel at Chernobyl. in what was formerly part of an engineered safety system suppression pool.

So the Soviets, in sum, have a very large nuclear program. It is much less than ours. They have two broad classes of plants: the light-water graphite-cooled reactors and the pressurized water-cooled reactors. It is hard to draw broad conclusions about relative safety because their plants are so different than ours. If you have questions, we can try to respond to them.

The CHAIRMAN. I guess I am interested, as much as anything, in plutonium production. Now, they produce a lot of it, don't they, with their type of reactors?

Dr. BUNCH. Well, let me try to speak to the fact that they have these 50-odd plants. The pressurized water reactor plants use enriched uranium from a ceramic fuel similar to the kind used in our commercial power reactors.

These are not well-suited for plutonium production because they basically are optimized, as Mr. Stello was pointing out, for baseload electricity production. The 22 Chernobyl-like plants that are either operating, or under construction, have changed in the last 5 or 6 years, from the Soviet literature.

When these plants were first being constructed and operated, they used relatively low enrichment uranium and did not leave the fuel in for a long time, which would make it possible, as was suggested, to extract that material and obtain plutonium from it.

My understanding from the Soviet literature is, in the last several years, the enrichment in these Chernobyl-like plants is roughly 2 percent enriched in uranium ^{235}. They keep the fuel in there a fairly long period of time, which suggests it is optimized primarily for electricity production.

I just do not know to what extent it is possible for them, nor whether they, in fact, do extract any portion of the spent fuel for plutonium use.

Mr. STELLO. Mr. Chairman, maybe I can help, too. As I understand it, the Soviets did not have the capability to manufacture the large pressure vessels and components typically used in pressurized water reactors, and were developing an industry to improve their capability to do so.

But at the same time they were trying to develop a design so that they could sell and build those plants outside the Soviet Union, and as I understand it, have decided to continue to build these types of plants, since, if you look at the design, you will notice they do not use the large, thick, heavy pressure vessels for this particular kind of a facility.

And, therefore, they could continue to build plants within the Soviet Union, without stressing their capability to manufacture components.

They were building a facility called Atomash, and I know they had considerable difficulty with that facility, in terms of being able to produce the kind of components necessary to build plants.

So, I believe that their decision was to continue to expand their nuclear program, and this was a reactor of the type that they could

continue to do so, without the need to have the capability to manufacture as many pressure vessels as they would need to support both building as many of the pressurized water plants as they wanted, as well as the Chernobyl-type plants, as well as several that they were building outside of the Soviet Union, and are selling to some of the satellite countries.

The CHAIRMAN. Speaking of outside the Soviet Union, is it true that the Soviet Union is building, or plans to build a nuclear plant in Cuba?

Mr. STELLO. It is my understanding they are, sir, and as I understand it, those reactors are of the type that Dr. Bunch described a moment ago as pressurized water reactors. They are the Western style reactor designs, similar to what we have in the United States.

The CHAIRMAN. Well, if that is true, what about the production of plutonium in Cuba?

Mr. STELLO. Well, as Dr. Bunch has already indicated, those reactors are not well suited for that purpose at all.

The CHAIRMAN. Well, in any case, there could be an accident in Cuba, as the saying goes, "90 miles off our shores."

I believe that kind of winds up my questions. I know so little about the technology of this. Let me do this. Would you gentlemen add whatever you think ought to be made a part of the record, because this is going to be distributed and printed.

Mr. STELLO. Well, based on the question you had asked earlier about levels of contamination and radiation measurements, I have had Dr. Congel prepare some documents that would help you understand those measurements that have been made, that we have good information about radiation levels and contamination levels.

The CHAIRMAN. Excellent.

Mr. STELLO. For those measurements, when they were made, and then how we use that information to help us understand it. With your permission, I would pass those out. I do not think we have enough copies. Do you have one for yourself? Unless you have overheads, we would talk from these and explain how we did the calculations.

The CHAIRMAN. We will make a copy of this available to each Senator on the committee.

All right, sir. You may proceed.

Dr. CONGEL. Mr. Chairman, I would like to give a quick summary of how we used the information that we had at hand to characterize the degree of severity of the accident at Chernobyl.

The first data that we received, that formed a rather complete base, was from Sweden primarily, with Finland giving us a good deal of information as well.

Since they detected it within a couple of days after the accident occurred, we were able to then calculate from those values, as measured in Sweden, back to, at least characterize the extent of the accident at Chernobyl.

In particular, we had measurements of a series of radionuclides including iodines and cesium, and also some measurements of the increased general radiation levels in the Stockholm, Sweden area.

On that basis, we looked at the wind patterns and looked at the models that we had developed over the years for American reactors, and tried to determine how much activity must have been re-

leased from the plant in order to result in those levels that far away.

We are talking distances of 700 to 1,000 miles. On the basis of that information we concluded rather quickly, that the accident was substantial in nature. That is, a significant fraction of the reactor fission products were indeed being released into the atmosphere. The greatest difficulty we had, as has been stated by speakers before me, is characterizing what happened close in to the reactor. The difficulty in doing that characterization is lack of knowledge of how the release actually took place.

Was it very, very warm, so that it went high in the atmosphere and then was carried large distances from the reactor? Or was it just moderately warm, with wind patterns that would bring it down closer to the reactor?

Until we get more detailed information on the site, we will not be able to characterize that. Because of the completeness of the data that we did get, first from the Swedes, then the Finns, and then also from a number of European countries, as shown in the handout that you have, we put together a time-dependent series of pictures.

The CHAIRMAN. Let me compliment you on this. This is great. You do it day by day, showing the time.

Dr. CONGEL. Yes, sir.

The CHAIRMAN. Excellent.

Dr. CONGEL. What we did: We looked at several different ways to present it. We tried to present it in a way that we felt was most meaningful, but of course we have to give you some caveats in interpreting these. What we used as a basis for shading in the countries for which we had data was to put in multiples of our PAG's. PAG means the Protective Action Guidance. These are levels that have been determined by the Food and Drug Administration as levels that are acceptable, that is up to those levels for American citizens to be exposed to, and then there are various action levels at values above these levels.

So, the first level of Protection Action Guidance is where you would take relatively easy steps to prevent the material from reaching the market. If you get 10 times these values, you absolutely prevent it from reaching the market and being consumed by American citizens.

Now these standards are not global; these are for the United States. Each of these countries that have presented data to us have different ones: some very similar, some a little bit higher, some a little bit lower. But they are all in the same ballpark.

So we looked at the data that we have presented to us and then characterized these in terms of multiples of these PAG's. So, for example, the parts that are shaded with the vertical lines, they had measurable levels of radioactivity in these countries and values well below our Protective Action Guides.

When we come to the cross-hatched area, we are getting close, like within a factor of two of the Protective Action Guides, and then the more densely shaded countries meant that they were in excess of our Protective Action Guides. And as you go day-by-day through this diagram, you will see the plume spread—roughly, of

course—but in somewhat accordance with the presentation we had earlier of the meteorological behavior of the plume.

I would like to emphasize that at the bottom of these figures we added part of the Far East—Japan and Korea, in particular, because about 7 or 8 days into the accident, we started to receive some environmental data from those countries as well.

The one conclusion we can draw from this data is that, indeed, even in countries like Poland, where we do not have a lot of internal information, that they were in a position where some foodstuffs had to be either confiscated or removed from the market.

I would be happy to fill you in with any other details that I can provide at this time.

The CHAIRMAN. This pretty well tells the story of how it spread. This is great. Yes, sir.

Mr. MEYERS. Senator, one point I should have made when I was here: You have a compilation of data that I have left with you and you will note in there that there are measurements for Russia and Poland.

By and large, we received no information from the Polish or Russian Governments, but the State Department asked us to send some of our own people to the embassies in Moscow and Warsaw, to take measurements in the embassy and around the grounds. We did that and those measurements are reported. They were relatively insignificant in those areas.

As I recall in the embassy itself, they were just about background levels, and outside the embassy, about three to five times background. So it was nothing for our people there to be concerned about.

Mr. STELLO. One last final point, Mr. Chairman. The IAEA has informed us that the Soviets have agreed to give us—I think it is about six readings each day—of radiation levels within the Soviet Union.

The closest one I believe is about 30 miles from the site, and the remaining areas that are being monitored are along the border of the Soviet Union, and we are to be provided with reports daily. I assume they are getting them in now.

The CHAIRMAN. Dating back to day one?

Mr. STELLO. No, I believe the first reports will provide information of radiation measurements as of Friday of last week.

The CHAIRMAN. Which was what?

Mr. STELLO. That would be the 7th or 8th of May.

The CHAIRMAN. Let's see. Friday was the 9th.

Mr. STELLO. Ninth.

The CHAIRMAN. Yes.

Mr. STELLO. So that is about 2 weeks after.

The CHAIRMAN. You fellows are fascinating. I appreciate your coming in, and it will be very helpful to the committee. Any other information that you think ought to be made a part of the record would be appreciated. It has been highly interesting to me. I wish I knew more about the subject so I could ask intelligent questions. But I appreciate it very much. Maybe you will need us some time, and let us help you.

Mr. STELLO. Thank you.

The CHAIRMAN. Thank you very much. The next witness is John Urbanchuk who is director of International Agricultural Research, Wharton Forecasting Associates. Mr. Urbanchuk will provide us with market analysis on the effects of the Chernobyl accident.

In addition, I hope he is going to tell us his thoughts on what would happen to the markets if other graphite reactors in the Soviet Union started popping off, as happened at Chernobyl. If you will have a seat, sir.

Yesterday, Senator McClure, chairman of the Energy Committee made an excellent contribution in a statement in the Congressional Record, and I think it ought to be made a part of our record, without objection, that will be done.

[The statement by Senator McClure with attached article follows:]

[Reprint from the Congressional Record, May 14, 1986]

THE FUTURE OF NUCLEAR POWER

Mr. McClure, Mr. President, over the past several weeks, the Senate Energy Committee has been immersed in a lot of issues concerning the future of nuclear power in this country. On the one hand, we have been closely following the recent nuclear accident that took place in Chernobyl, Russia. While we appreciate the fact that, given the major differences in technology and safety features between United States and Russian reactors, we will never see the kind of consequences here that Russia experienced at its plant, we are nevertheless extremely worried about the indirect impact of this accident on the future of nuclear power in this country. If the Chernobyl accident does nothing more than further taint public perception of the safety of nuclear power in this country, then that accident will have taken a serious toll here.

This brings me to the brighter side of the committee's recent activities, and that is the hearings we held April 29 and May 5 on the Department of Energy's programs in nuclear energy research and development. During these hearings, we heard from a variety of witnesses ranging from the Department of Energy to the National Association of Regulatory Utility Commissioners.

Mr. President, one of the most important messages that came out of these hearings was the fact that not only do we have a proven light-water reactor technology in hand that produces safe, clean, and economical electricity in this country, but we also have at our fingertips a whole new "second generation" of nuclear plants that promise the kinds of advancements in terms of "walk-away" safety, economic, and proliferation resistance, that can put issues such as the "Chernobyl Syndrome" behind us for good.

I cannot think of a better example of this than what is described in the article in the May 2 issue on the Wall Street Journal. This article summarizes the recent tests conducted at the Experimental Breeder Reactor No. 2 in Idaho. Clearly, these tests demonstrate that reactors can be designed in such a manner that no conceivable event, whether it be mechanical failure or human error, will have any significant impact on public health and safety, nor for that matter any significant impact on the plant itself.

It is research such as that being performed at the Experimental Breeder Reactor No. 2 for the Department of Energy that will leapfrog U.S. nuclear technology into a new era of inherently safe reactor technology. I am certain that, even when subjected to rigorous public scrutiny, these advanced reactor designs and will endure.

Mr. President, I ask that the May 2 Wall Street Journal article to which I referred be made a part of the Record.

The article follows:

ENGINEERS TAKE DIFFERENT PATH IN SEARCH FOR A SAFER REACTOR

(By Jerry E. Bishop)

On the morning of April 3, three weeks before the Chernobyl nuclear disaster in the Ukraine, a small, 20,000-kilowatt atomic reactor in Idaho, operating at full power, suddenly underwent one of the most dreaded occurrences in the production of nuclear power: The fluid that is supposed to cool the reactor stopped flowing.

Had this happened in a commercial power reactor, as it did at Three Mile Island in 1979 and possibly at Chernobyl last Saturday, another nuclear disaster would have been in the making. The cooling fluid would have immediately boiled away and temperatures in the reactor would have soared in minutes. Reactor operators would have scrambled frantically to get control rods pushed into the reactor to stop the atomic chain reaction before a "meltdown" of the uranium fuel core occurred.

When the loss-of-coolant incident took place in the Idaho reactor, however, engineers sat quietly, waiting to see what would happen. The temperature of the coolant did rise by 400 degrees Fahrenheit, but it didn't boil and continued to extract heat from the reactor. The atomic reaction stopped, and the coolant temperature dropped within five minutes to its normal 900 degrees.

The incident was the latest test by Argonne National Laboratory engineers of an advanced atomic power reactor that researchers claim is inherently safe. Known as experimental breeder reactor No. 2, or EBR-II, it is markedly different from the reactors that currently power the world's commerical nuclear electric-generating stations. The cooling fluid, which circulates through the reactor core, extracts heat from the reactor and transfers it outside where the heat is used to produce steam, is liquid sodium instead of water. And the uranium fuel is a metallic alloy instead of uranium oxide. These basic changes produce an atomic reactor that, according to the laws of thermodynamics and physics, can't go out of control.

Most commercial power plants use water to cool their reactors. Water boils at 212 degrees. To prevent the water from boiling away and allowing the reactor to overheat and melt, the cooling water has to be kept under pressures more than 100 times atmospheric pressure. Sodium, however, has a boiling point of 1,650 degrees and can keep absorbing the reactor's heat, cooling it, until it reaches that temperature. For this reason, the sodium doesn't have to be kept under pressure, one inherent safety advantage of the EBR-II.

Another safety feature is metallic uranium fuel. The metallic fuel is a far better conductor of heat than the oxide fuel used in commercial reactors. When the metallic fuel begins to overheat, the heat is quickly and efficiently conducted to the sodium coolant instead of building up inside the fuel as it does with the oxide fuel. As the heat spreads out evenly through the fuel, the sodium and the control rods, everything begins to expand. The expansion spreads the uranium atoms apart, slowing down the atomic chain reaction without any human or mechanical intervention. As the reaction slows, the temperature drops back to normal operating levels.

The EBR-II actually was built in 1964 to test out the concept of immersing a reactor in thousands of gallons of liquid sodium. But, says Charles Till, the associate laboratory director in charge of the Argonne program at the Department of Energy's Idaho experimental reactor facility. "Only in the last year or so did it become apparent that the reactor was inherently safe." After extensive experiments and computer simulations, the engineers, decided, perhaps for the first time in history, to subject an atomic reactor to the three most dreaded "postulated hypothetical accidents" that could happen to a nuclear reactor.

In the test on April 3, the circulation of the primary sodium coolant through the reactor was stopped. As predicted, the temperature of the sodium rose, and in minutes the power from the reactor dropped to almost zero as the chain reaction stopped, Mr. Till reports. That afternoon, in a second test, the flow of the secondary cooling system, which removes heat from the main system and transfers it outside the reactor, was suddenly shut down. Again, after a brief temperature rise, the atomic chain reaction came to a standstill and temperatures dropped to normal.

The engineers plan soon to put the EBR-II through the third-worst hypothetical accident, "an uncontrolled acceleration of reactivity," as it's called. If, in a conventional reactor, a vital control rod is accidentally pulled out of the reactor, the atomic chain reaction could get out of control, sending out lethal blasts of radiation and resulting in a core meltdown. The Argonne engineers are certain that when they jerk a control rod out of the EBR-II, the same phenomenon that prevented the other accidents will shut the reactor down.

Argonne, which is operated for the DOE by the University of Chicago, is now developing a prototype commerical power reactor, called the integral fast reactor (IFR), based on the EBR-II concept. If techniques for reprocessing the metallic fuel are worked out, researchers believe such inherently safe reactors could be operating in 15 years.

The CHAIRMAN. We can abide by the rules of the Senate. We cannot meet, within the rules of the Senate, past 1 o'clock, but there is a way of getting around that. Let us, at the outset, make

your prepared statement a part of the record.[1] So that is in the record before 1 o'clock. Please proceed.

How about proceeding a little bit, and the clock will stop on us, you know. I will not observe the time.

STATEMENT OF JOHN M. URBANCHUK, DIRECTOR OF INTERNATIONAL AGRICULTURAL RESEARCH, WHARTON FORECASTING ASSOCIATES, PHILADELPHIA, PA

Dr. URBANCHUK. Thank you very much, Senator. I am delighted to be here before the committee to discuss the views of Wharton Econometrics on the agricultural and the economic impacts of the Chernobyl disaster.

As Senator Abdnor indicated, last week I had the privilege of presenting testimony to the Agriculture and Transportation Subcommittee of the JEC, the Joint Economic Committee, on exactly this topic.

And what I have done is, I have essentially expanded my testimony to that particular committee in a couple of different areas.

Based on the information that we have gotten about the accident and the contamination, and including the information that has come out this morning, it is our opinion that the Chernobyl accident is unlikely to result in a substantial disaster for either the current Soviet crop, or have a persistent long-lasting impact on Soviet agriculture.

Now I would like to clarify that a little bit because we found out this morning how much we really do not know, and I am not an expert on contamination or its impacts. I should say that outright.

And I will come back to that. Moreover, given the current record global surplus of wheat and coarse grains, this accident is also unlikely to present a threat to world security or food security.

It does seem, however, likely, that the Soviets may increase imports of grains, vegetable oils, and dairy products, and meat over at least the next year.

These stepped up imports will be welcomed by the world grain markets and should benefit the European Community, Canada, Argentina, and the United States as well.

Ironically, perhaps the most severe immediate economic impact will not really be on the Soviet Union at all. Clearly there will be an adverse impact.

But it is most likely to be felt in the East European countries, particularly those of Poland, Hungary, and Yugoslavia. Due to the recent import embargo placed upon those countries, in fact all the East European economies with the exception of East Germany, by the European Community. I will talk about that in a little bit as well.

I have taken the liberty of preparing a transparency that I would like to put up here, to do two things, if we could do that.

The CHAIRMAN. All right. Here is a microphone, if you want to stand up, or whatever.

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[1] See p. 45 for the prepared statement of Mr. Urbanchuk.

CHERNOBYL

MAXIMUM REPORTED CONTAMINATION LEVELS VS. LOWER LIMIT PAG

APRIL 28, 1986

Dr. URBANCHUK. Now this is another map, but what I hope to accomplish with this map is to do two things. Now this is a polar projection, so the scales on the map are a little bit different in the sense that the location of East European countries—Poland, the German Democratic Republic, Federal Republic of Germany, and Scandinavia, appear in different a place than we saw on the other maps.

What we have done is, we have taken the Ukrainian Republic and colored it in green; that is the entire Ukraine. That represents about 13.5 percent of the total harvested area of all grains in the Soviet Union.

I have indicated at the epicenter of these two yellow circles the Chernobyl plant and the radius of each of these circles—the inner circle is a 100 kilometers, roughly 60 miles, and the outside circle is 200 kilometers or about 120 miles, to give you some idea of the scales, in terms of distances that we are talking about.

And many of the factual informations with regard to production of crops and livestock were covered more than adequately by Bob Thompson this morning, so I will not go over that again.

But the point of the matter is that the four oblasts that he talked about—and I am pointing to here, three in the Ukraine and one in Belorussia just north of the plant—are not terribly significant agriculture producing areas.

As a result, the immediate impacts of the accident, in terms of localized agriculture will not have that severe an impact on, or should not, I should say, have that severe an impact on total Soviet production, either this year—now there is some skepticism and doubt about what it is likely to do for the subsequent crops, particularly the one that will be planted this spring for harvest in the fall, or for the next several years.

I would like to also use the map to point out—and we took away Ron Phillips' map earlier, that had the location of the other nuclear reactors in that area of the Soviet Union.

But basically, if you take a look at that, you will find that the other reactors in the Soviet Union, aside from Chernobyl, are located to the east, the south, along the Crimea, around here, and up in this area.

There are similar reactors up in the area here to the north of the RSFSR, and Estonia, and then there are a few located down in the Kazakh region as well.

Now if we expand—and you asked the question of what would the likely impacts be if we had similar accidents to Chernobyl and other areas, keeping in mind that that concentration is in the major wheat-producing areas of the southeast and in the southwest Ukraine, we could have more significant or more severe implications from similar types of accidents in other plants as well.

I would also like to point out that within the Ukrainian economy itself, about 60 percent of total Ukrainian electricity is generated by nuclear energy with 15 percent of it coming from Chernobyl alone. So that the concentration of power generated by nuclear energy and its prominence in the Ukraine is quite large.

The areas of most severe, or most serious agricultural production, of course, stretch along this particular range right in here.

You have got the Ukraine, which accounts for about 37 percent of the total wheat production in the Soviet Union, and then the New Lands area which stretch into the Kazakh region in Kazakhstan in here, and when you take those two republics together Kazakhstan and the Ukraine, you have got the two largest grain-producing regions in the Soviet economy.

So that if we had similar disasters in other areas, particularly in southeast, or in southwest Ukraine, the consequences with regard to agricultural production could be considerably larger than I think they are likely to be from the Chernobyl incident.

That gives you an idea of basically where we are going with that. I will leave that up there, and answer some questions, if you have got them, with regard to that.

I am not going to take time to read through the whole testimony about that.

The CHAIRMAN. Yes, sir. We have passed our 1 o'clock deadline. By the rules this man is supposed to stop now. Let me file my questions in writing. I just have one oral question. Of course it is going to depend on a lot of things, but what you are saying to me, if they have one more accident down in the lower region, that is going to affect the grain situation in a lot of countries, isn't it?

Dr. URBANCHUK. Well, not necessarily in a lot of countries, and I think the gentlemen that preceded me this morning, based on what they have said, it is going to depend on a number of things. The type of accident; the type of contamination: the type of isotopes that are released. All those things.

The CHAIRMAN. Right.

Dr. URBANCHUK. Plus the time of the year, and the prevailing wind patterns and weather patterns this year carried the radiation in one way. We cannot be certain that that would happen again.

The point is, that if we lost the full Ukrainian grain crop—the Ukraine accounts for about 20 percent of Soviet grain production—it is unlikely that we would lose the full Ukrainian grain crop under almost any circumstance that I could conjure up.

I have in my testimony come up with a 10-percent maximum potential loss, that could result from this type of an incident and that is basically what we have calculated into our estimates.

The CHAIRMAN. I see.

Dr. URBANCHUK. The point of what I am saying, I suspect is that when you take a look at the normal variations in Soviet grain production due to weather changes, and what has been experienced over the past 20 years, that kind of a loss, a maximum potential of 10 percent, and I do not think that that is going to be the likely outcome of this particular incident by a long shot.

But that falls within that normal range of variation.

The CHAIRMAN. I see.

Dr. URBANCHUK. So, it does not portend to be a disaster for Soviet grain production at this time. So that the impact on the rest of the world markets, again, is likely to be not very large, largely because we have got record levels of surpluses on a global—both in the United States, but on a global basis in wheat and coarse grains.

There is more than enough grain to meet any additional import requirements by the Soviets or any East European countries for that matter, without adversely affecting prices.

The CHAIRMAN. Thank you very much for going to all this trouble for us, and for your patience. I am sorry we got started late on this part of our schedule today.

Dr. URBANCHUK. I would be delighted to respond to your questions. If you will provide them to me, I will give as much detail and be as prompt as I can.

The CHAIRMAN. I certainly will. Again we are most grateful. If there is no further business to come before the committee, we will adjourn.

[Whereupon, at 1:07 p.m., the committee adjourned, subject to the call of the Chair.]

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APPENDIX

STATEMENT OF HON. THAD COCHRAN, A U.S. SENATOR FROM MISSISSIPPI

Thank you, Mr. Chairman for calling this hearing on a matter of great concern and urgency. This disaster has the potential of having a great deal of impact on the American people as a whole and the agricultural industry in particular.

The entire area affected by this nuclear disaster is very critical to agricultural production in the Soviet Union. This area, located on the northern edge of the Ukraine, produces about 23 percent of the food for the Soviet Union. Specific crops produced include nonirrigated sugarbeets, potatoes, and livestock. However, winds have now blown contamination over the winter wheat areas of the Ukraine as well as many other areas of Western Europe. We are hearing many stories of dairy products in Poland being removed from stores, various countries not accepting vegetables which were produced in areas with potential contamination and other adversities being experienced; however, the most alarming fact to me is what we are not hearing, whether by design or by lack of factual scientific findings.

As you know Mr. Chairman, I serve as Chairman of the Governmental Affairs Subcommittee on Energy, Nuclear Proliferation, and Government Processes. Our subcommittee has reviewed the issues involved in the area of international safety following the Chernobyl disaster.

Thank you again, Mr. Chairman, for holding this hearing to learn about the impact this disaster could have on the agricultural industry.

STATEMENT OF HON. EDWARD ZORINSKY, A U.S. SENATOR FROM NEBRASKA

Mr. Chairman, the tragic accident at the Chernobyl nuclear plant emphasizes the critical need for strict adherence to nuclear safety standards to ensure the public health and to protect the food supply.

The citizens of our Nation can be grateful that they have an abundant supply of safe, high-quality foods, but they cannot afford to be complacent about protecting the safety of that food supply. As a matter of national security, the United States must take every precaution to ensure that its food supply is never in jeopardy from a nuclear accident.

The lack of official information available from the Soviet government concerning the accident is disturbing. However,

current estimates of the effect of the Chernobyl accident indicate little lasting effect on the food producing capability of the Soviet Union or its neighbors. Too, it appears that the people of the United States will not experience any serious adverse health effects from the release of radioactivity. American foods are safe to eat, and American milk is safe to drink.

Mr. Chairman, I look forward to reviewing today's testimony.

STATEMENT OF HON. PATRICK LEAHY, A U.S. SENATOR FROM VERMONT

Mr. Chairman, I hope that this hearing will provide the public with increased understanding of the terrible effects on nature that can occur if nuclear forces are released.

Americans can be thankful that they have an abundance of safe, high-quality foods--grains, meat, and milk. We must make every effort to protect that food supply. Many occurrences can pose a very real threat to the food supply--an accident such as the meltdown of the Chernobyl plant underscores the importance of strict adherence to nuclear safety standards. While the current estimates of the effect of that disaster appear to indicate little lasting effect on the Soviet food producing capability, matters could have been much worse. As a matter of national security, the United States must be sure that its food supply is never in jeopardy from a nuclear accident.

All of us were dismayed at the lack of information officially available from the Soviet government concerning the Chernobyl accident. However, it now appears that citizens in the United States and other nations will not experience direct adverse health effects from the release of nuclear energy at the meltdown. American people will not be subject to hazardous levels of radiation from Chernobyl, American foods are safe to eat, and American milk is safe to drink.

Mr. Chairman, I look forward to reviewing today's testimony.

STATEMENT OF HON. ALAN J. DIXON, A U.S. SENATOR FROM ILLINOIS

Mr. Chairman, I commend you for calling this hearing regarding the possible impact of the Soviet nuclear disaster at Chernobyl on world agriculture.

Several weeks ago, my office contacted the Foreign Agricultural Service, at the U.S. Department of Agriculture, in an effort to find out what effect this tragedy might have on agriculture in the Soviet Union and across the world. At that time, we were informed that it was too early to know exactly what effect the nuclear disaster will have on Soviet grain production.

According to the Foreign Agricultural Service, even when more information becomes available about the severity of the contamination, a number of problems remain. First, the Soviets haven't released information on yields or production of grains since 1980. Area data is given, however. From that, the U.S. estimates yields and production. Since we don't have solid

information, even under normal circumstances, it might be impossible to assess the impact.

Second, we cannot be certain in what direction the winds were blowing, if they were contaminated, and if so, with what intensity.

The Foreign Agricultural Service determined that the USSR, as a whole, produced 118 million hectares (2.471 acres per hectare) of grain last year; 16 million hectares were produced in the Ukraine. However, the Department does not know exactly where the grain is produced in the Ukraine, whether or not it is in the immediate vicinity of Chernobyl, and what effect the cloud of radiation might have on grain production.

Because there is a question about the contamination of the water supply, irrigated crops may also be in danger.

I am hopeful that we will get a full update this morning on what progress the Department of Agriculture has made in assessing the impact of the Chernobyl disaster.

Mr. Chairman, at this point, I would also like to emphasize the importance of getting fresh supplies to the people of Poland and other countries in the region. Last week, my colleague from Illinois, Senator Simon, and I introduced a resolution urging the Department of Agriculture to supply 50,000 tons of powdered milk to the people of Poland. Additionally, Chairman Helms and I have worked on a letter to the Secretary of Agriculture on this matter. I urge my colleagues on the Agriculture Committee to join us in our efforts to assist the people of Poland.

Thank you, Mr. Chairman.

STATEMENT OF ROBERT L. THOMPSON, ASSISTANT SECRETARY FOR ECONOMICS, U.S. DEPARTMENT OF AGRICULTURE

Mr. Chairman and Committee Members, I am pleased to appear before you today to discuss the potential impact on agriculture of Chernobyl accident.

We me are several witnesses who will assist in responding to your questions. They are: James R. Donald, Chairman of USDA's World Agricultural Outlook Board; Mary E. Carter, Associate Administrator of USDA's Agricultural Research Service; Lester M. Crawford, Associate Administrator of USDA's Food Safety and Inspection Service who has served on the White House Task Force on the Chernobyl incident; and Norton D. Strommen, USDA's Chief Meteorologist.

In addition, available to provide technical expertise and support are Keith Severin of the Foreign Production Estimates Division of USDA's Foreign Agricultural Service; and Kathryn A. Zeimetz, Chief, of the Eastern Europe and USSR Branch of USDA's Economic Research Service. Biographies of all have been submitted for the record.

Areas of Concern

In your letter requesting this hearing, three areas of concern were cited: first, the impact of the accident on Soviet and European agriculture; second, the potential for disasters at similar reactors throughout the USSR and the possible impact of such disasters on agricultural production; and third, the

possibility that the degree of threat to agriculture was related to possible military designation of the reactor at Chernobyl.

From the start, Mr. Chairman, I respectfully submit that while the Department of Agriculture will attempt to respond to the first concern today, the other two issues are far beyond USDA's realm of responsibility. I share this Committee's concerns for all ramifications of the Chernobyl accident on world agriculture. However, at the outset, I must emphasize that what we don't know far exceeds what we do know; that USDA simply is unable to comment on other reactors in the USSR or military versus civilian use of the reactor at Chernobyl.

As you know, information from the USSR concerning any aspect of the accident has been limited, and I would caution that until we know what hit the ground and the water, assessment is impossible. As you know, within the U.S. Government, a well-functioning and orderly process was immediately established by President Reagan to deal with all areas of concern. The White House Task Force, headed by the Environmental Protection Agency, has been a central point to which all of us have turned.

However, for the Task Force as a whole, or its member parts such as USDA, speculation never can be substituted for information that simply is not available. Those of us involved in agriculture have a further responsibility to avoid disruption to markets rocked initially by conjecture about impacts of Chernobyl.

Thus, as I address this Committee, I must remind you of the factual void facing us, and hope that the Members here today will be patient if many of our responses begin, "we do not know." Hopefully, in time, we Will know these answers and have the privilege of sharing them with this body.

Production and Technical Information

Although information on agriculture in the region around the reactor is limited, it is adequate to provide estimates of normal levels of production. Some technical information is available on the impacts of varying levels of radioactive contamination. We also know what the Soviet weather patterns were at the time of the Chernobyl accident, and these data can be used to identify areas potentially exposed to contamination. However, there is little information available on the nature and extent of overall contamination; lacking this, assessment is only tentative at best.

Weather Since April 26

As the world now knows, beginning at 1:23 a.m., April 26 Kievtime; a series of events occurred at the Chernobyl nuclear facility near Kiev in the Soviet Union, leading to a fire, explosion and core meltdown. The explosion and fire released a plume of radioactive materials into the air. Air mixing at the vicinity of the accident site caused fallout to be transported both by winds at the surface and at upper levels of the atmosphere. The radioactive plume traveled northwest and then west toward East European and Scandinavian countries and has since dispersed widely throughout the Northern Hemisphere.

The Chernobyl plant is in the extreme Northern Ukraine, north of Kiev. Weather conditions since the accident suggest areas immediately around the site were exposed to surface contamination while a larger area, mostly to the north, was exposed to wind-born

contamination. A brief description of daily weather conditions since the accident follows.

-- On April 26, surface winds blew towards the northwest over areas of Belorussia, the Baltic States and northeast Poland--all minor grain-producing areas. Showers and thunderstorms were reported in the area of the plant.

-- On April 27, the air flow moved toward western Belorussia and Poland.

-- On April 30, gentle surface winds shifted very briefly toward more important grain-producing areas of the northern Ukraine and the Black Soils Region.

-- By May 1, wind speeds increased and reversed direction, heading toward the western Ukraine into southeastern Europe. By day's end, radiation release reportedly was significantly contained, thus reducing wind-born radiation after this date.

-- From May 2-5, winds shifted toward the southeast and slowed by May 6. One May 7 and 8, widespread showers feel over Chernobyl and in other parts of the region.

-- On May 9, light rain continued over the Ukraine, and from the Urals eastward into the New Lands.

-- Early this week, scattered light showers fell and winds continued light and variable around Chernobyl.

Effects of Contamination on Agriculture

Agricultural production--both crop and livestock--can be affected by exposure to contaminants, by measures taken to avoid exposure, as well as by decontamination measures. The nature of radiation's effects depends on many variables, such as types of isotopes present, dosage, stage of crop growth, crop canopy, and soil type and quality.

Other considerations in this complex equation include rainfall and the topogrpahy of the land and drainage and/or run-off from the field. These elements can adversely affect water quality for humans, animals, and irrigated agriculture. Short-lasting isotpes, usually about half of radiation and consisting principally of iodine-131 and barium-140, dissipate in a matter of days, whereas radiation from the long-lasting isotopes, such as cesium-137 and strontium-90, remain after decades.

Sheltering and washing agricultural materials are measures used to deal with immediate exposure effects to both types of isotopes. Additional measures include keeping animals from contaminated pastures for days to weeks and storing contaminated agricultural products for an appropriate period to allow for dissipation of radiation.

The effects of long-lasting isotopes are much more difficult to assess and counteract. In extreme cases, abandonment of affected areas for up to decades could be required. It is unclear at present, however, whether such restriction will be applied by the Soviets on any of its agricultural land.

Agriculture in the Area of Chernobyl

The Chernobyl power plant is located in the extreme northern Ukraine in the western USSR, about 8 miles from Belorussia. The Soviets report that people were evacuated from a zone 18 miles around the plant. There are conflicting reports regarding livestock slaughter versus evacuation in the 18-mile zone. The Soviet media contains a number of reports about normal

agricultural operations in the general area outside the ring, but little information concerning quarantine procedures for milk or fresh vegetables.

It is important to emphasize that at this time there is no information to support theories that agriculture in most of the Ukraine and Belorussia have suffered or will suffer from significant radiation damage. The area close to Chernobyl is not important agriculturally.

To help perceive the area and productivity around Chernobyl, it may help to consider oblasts. An oblast is an administrative sub-division of a republic. Sizeable parts of four oblasts lie with a 100-miles radius of Chernobyl. These four account for about 4 percent of Soviet agricultural output, 3 percent of Soviet grain output, 4-5 percent of meat and milk production, and about 10 percent of Soviet sugar beet production.

The Baltics and Belorussia, areas believed under the initial plume, produce on average about 5 percent of Soviet grain, 20 percent of the potatoes, 10 percent of the meat, and 15 percent of the milk produced in the USSR. Areas to the southwest of the plant, also subject to wind-born contamination, produce an estimated 5 percent of the grains, 10-15 percent of the potatoes, 5-10 percent of the meat and milk, and over a quarter of the sugar beets produced in the USSR.

Factors Affecting Soviet Response

A number of technical factors about the Soviet agricultural sector may affect their response to a contamination threat. The Soviets make extensive use of confinement in their livestock sector and routinely shelter livestock. Large amounts of haylage and silage are stored in open trenches. Transport system limitations could impeded shifting agricultural supplies into and out of the affected areas.

The Soviets rely on large imports of agricultural commodities, estimated at more than $17 billion in 1985. Grain imports reached an estimated record 55-56 million tons in the 1984/85 marketing year, following 1984's estimated 170-million-ton grain harvest. The latest USDA estimate of USSR grain imports for 1986/87 are 30 million.

Lower world market prices for oil and difficulties in maintaining oil export volumes to Western customers threaten a major decline in Soviet hard currency earnings in 1986. However, world grain prices are expected to be lower.

Eastern European Agriculture

Virtually all of Eastern Europe--Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania and Yugoslavia--a region of 140 million people, lies beyond a 300-mile radius of the accident site. In northeastern Poland, concentration of contaminants was reported as significant, although below the danger point except for iodine-131 concentration in fresh milk. Also, Romania and Hungary have been identified as possible problem areas.

Northeastern Poland contains a third of the Polish population and produces about the same proportion of the country's meat, milk and grain. The eight Eastern European countries together are an important producing and trading region, producing about 6 percent of all world grain, 8 percent of world meat supplies and nearly 20

percent of the world potato crop. It exports nearly 20 percent of world meat trade, and imports close to 4 percent of world grain exports. In Eastern European agriculture, there is more emphasis on fresh green fodders in livestock operations than in Western Europe or North America. Also, open storage of much of the grain and feed would increase the risk of contamination of livestock feeds.

Eastern European Response

Poland was first to take preventative measures in response to contamination which included: (1) a ban on the consumption of milk from grass-fed cows; (2) keeping cattle in barns during the emergencies; (3) oral administration of thyroid-protective does of potassium iodide to children and pregnant women; (4) washing of all fresh vegetables before consumption. These measures also were adopted in Hungary, Austria and Romania and to some extent in other neighboring countries, notably Italy, West Germany and Switzerland.

As with the USSR, there is insufficient information to forecast any possible change in import demand as a result of the accident. Eastern European agricultural imports have been constrained in recent years by a shortage of foreign exchange, a situation which still exists.

Eastern Europe's exports, however, already are being affected by the accident, at least in the short-run. The Scandinavian countries have imposed radiation level checks on fresh food imports and on imports of food that was processed on or after April 25. On May 12, the European Community imposed a ban--to be reviewed on May 31--on farm product imports from Bulgaria, Czechoslovkia, Hungary, Poland, Romania, and Yugoslavia, as well as from the Soviet Union.

Implications for the U.S. Food System

Information is insufficient to assess the possible impact on agricultural imports by the Soviets and Eastern Europeans. U.S. grain exports to the USSR reached a record of more than 22 million tons in the 1984/85 July-June year, but sales have been much lower in the current year. U.S. sales to Eastern Europe have been depressed since the debt crisis affected the region in the early 1980's. For example, imports of U.S. grain declined from 7.2 million tons a year in 1976-80 period to about 1 million in 1985.

The United States and other exporters have huge supplies of surplus wheat and feed grains available--world stocks at the end of 1985/86 are expected to be the equivalent of 166 percent of 1985/86 world trade. Although wheat production by the major exporting countries in 1985/86 was down by 16 million tons, record beginning stocks and an expected 5-million-ton drop in their exports will leave huge ending stocks. In 1985/86, the major foreign wheat exporters are expected to show an 8-million-ton increase in production. Feed grain production by the major foreign exporters rose 5 percent in 1985/86. The competitors' production, large beginning stocks, and a slump in world trade is expected to result in a carryover 60 percent above 1983/84.

World meat and dairy stocks are at high levels. The EC recently sold the USSR 385 million pounds of beef from its intervention stocks at 12 cents a pound for forequarters and 26 cents for hindquarters. This large sale only puts a dent in EC stocks which

totaled 2.5 billion pounds at the beginning of 1986. The U.S. whole-herd buyout also is expected to add to world meat supplies. EC intervention stocks of butter exceed 2.5 billion pounds and intervention stocks of nonfat dry milk are 1.5 billion pounds.

More than 90 percent of the $8.6 million of U.S. agricultural imports from the USSR in 1985 is in furskins. Processed pork is the most important category of food product imported from Eastern Europe, accounting for 1.3 percent of total U.S. pork consumption. Hops, tobacco, cheese, fresh and preserved fruit and juices are other import items. USDA's Food Safety and Inspection Service and the Food and Drug Administration are reviewing standards for radioactive contamination of food to make sure they are adequate, and will send them to European countries that export meat to the United States. FSIS samples and monitors meats at the port of entry in the United States.

Thank you, Mr. Chairman. This concludes my prepared statement.

STATEMENT OF VICTOR STELLO, EXECUTIVE DIRECTOR FOR OPERATIONS U.S. NUCLEAR REGULATORY COMMISSION

Mr. Chairman, at your request, I appear before the Committee today to discuss the Soviet accident at Chernobyl and be responsive to any questions the Committee may have.

As you may know, details regarding the accident are sketchy. However, the available evidence indicates that the accident was serious. I would like to express my condolences to those Soviet citizens, and others, who have been or might be impacted because of the accident at Chernobyl. It is obviously a matter of deep concern to us all when tragedies occur. The President has offered to provide appropriate medical and technical assistance.

The White House has established an interagency task force to monitor the health, safety and environmental consequences of the Chernobyl accident. The task force is chaired by Lee Thomas, Administrator of the U.S. Environmental Protection Agency. Members represent various Federal agencies, including the Nuclear Regulatory Commission (NRC).

An NRC Incident Tracking Team was established on May 1, 1986 to collect information and review the effects of the Chernobyl incident in support of EPA. The purpose of the effort is to obtain an understanding of the reactor accident and the radiological source term in order to assist EPA in assessing its input to the United States.

As you are aware, Mr. Chairman, we had a serious accident in the United States at the Three Mile Island Unit 2 Facility. Our study of that accident produced an extensive list of changes that the Commission concluded were necessary to improve the safety of nuclear plants in the United States. Because of the significant differences between the commercial nuclear plants in operation in the United States and the Chernobyl nuclear facility in the Soviet Union, it is difficult to anticipate any lessons to be learned from this accident that might be applicable to plants we regulate.

We, of course, will make every effort to learn what we can from the Soviets, but until we have sufficient information, it is premature to speculate whether any changes in United States' commercial plants are warranted. We have appointed a group of our

senior scientists and engineers to continue the study of the accident and recommend to the Commission any action that might be needed for the U.S. regulatory program.

Let me provide a brief depiction of our existing knowledge of the Soviet accident after which I will be pleased to respond to any questions you may have.

STATEMENT OF JOHN M. URBANCHUK, DIRECTOR, INTERNATIONAL AGRICULTURE, WHARTON ECONOMETRIC FORECASTING ASSOCIATES, INC.

Summary and Introduction

Mr. Chairman, I am pleased to appear before this Committee to discuss the views of Wharton Econometrics on the economic and agricultural impacts of the Chernobyl nuclear disaster.

Experts on the nuclear power industry and effects of radioactivity and nuclear fallout, both in the United States and in Europe, are concluding that the accident at the Soviet nuclear power plant at Chernobyl in the Ukraine on April 26, 1986 is the worst such accident in history.

Although Soviet authorities have declared the accident officially over, details on the full extent of the accident and the resultant radioactive contamination of the population, land, and water supply in the Ukraine and neighboring Belorussia, are not yet known. We do know however that a chemical explosion which destroyed part of the plant, a fire centered in the nuclear fuel rods, and at least a partial core meltdown, resulted in a substantial release of radioactivity that affected Scandanavia and Central Europe, and has been detected in small amounts in the United States.

Concerns over the impact of radioactive contamination of the Ukrainian grain crop and livestock inventory, and potential impact on total Soviet crop production and import demand were reflected in the three most active days the U.S. and world commodity markets have experienced since the drought of 1983. The activity was not limited to grains and oilseeds as livestock markets reacted to the fear that contamination of meat and dairy products in Poland and Scandanavia would reduce U.S. imports of processed meat and cheeses from those countries.

Based on information made public to date about the accident and contamination, it is our opinion that the Chernobyl accident is unlikely to result in a disaster for the current Soviet crop, or have a persistent or long lasting impact on Soviet agriculture. Moreover, given the current record global surpluses of wheat and coarse grains, the accident is also unlikely to provide a threat to world food security. I does seem likely, however, that the Soviets may increase imports of grain, vegetable oils, dairy products, and meat over at least the next year. These stepped up imports will be welcomed by the world grain markets and should benefit the European Community, Canada, Argentina, and the United States.

Impact of Chernobyl on Soviet Agriculture

There are several ways that radioactive contamination could adversely impact agricultural production in the Soviet Union and

surrounding areas subjected to fallout from the Chernobyl disaster.

- o Radioactivity may contaminate the existing crops, primarily maturing winter grains, rendering them unusable.
- o Agricultural land could be contaminated so severely that crops could not be harvested, or prepared for planting summer crops.
- o Ground and/or subsurface water supplies could be contaminated thereby endangering crops.
- o Livestock herds could receive such severe contamination that they would have to be liquidated. The meat may or may not be consumable.
- o Milk supplies will be contaminated by the pass through of radioactive isotopes by dairy cows.
- o Fruits and vegetables may be contaminated by fallout.

At the outset is must be admitted that I am not an expert on the effects of radioactive contamination on crops or livestock. Further, even experts in these fields are at a disadvantage in analyzing the impact due to the paucity of solid information about the isotopes released, rates of release, and contamination levels in specific agricultural areas. Due to the paranoia endemic to the Soviet system it is questionable whether this information will ever become officially available.

Based on published information and statements of U.S. and European governments, it appears that the most substantial aerial contamination was concentrated in the immediate vicinity of Pripyat where the Chernobyl reactor is located, and areas to the north and northwest (see map 1, p. 47.) Apparently some contamination of the reservoir that supplies Kiev and the Dnepr River has taken place. As a result, in addition to Kiev Oblast where the plant is located, at least half of the Ukraine, and virtually all of Belorussia, would have received considerable radioactive contamination. Additionally, Lithuania, Latvia, and Estonia, as well as the western Oblasts of the RSFSR, may have been exposed. Outside the Soviet Union, the northern tier of East European countries and Scandanvian have also reviewed damaging amounts of radiation from the incident.

Grains

While the Soviet Union has not released grain production figures on either a national or republic basis since 1980, official Soviet statistics indicate that three republics -- the RSFSR, Ukraine, and Kazakhstan -- accounted for about 93 percent of total grain area in 1985. Area harvested in the Ukraine represented 13.5 percent of total Soviet grain area. A breakout of grain area by republic for 1985 is displayed in Table 1.

RUSSIAN SOVIET FEDERATED SOCIALIST REPUBLIC
(RSFSR)
Norway
Sweden
Finland
Poland
KAZAKH SSR
UZBEK SSR
TURKMEN SSR
KIRGIZ SSR
TADZHIK SSR
Afghanistan
Turkey
Krasnoyarsk
Kray

MAP 1

Table 1

Soviet Union: Area for Selected Grain by Republic - 1985
(Million Hectares)

	RSFSR	UKRAINE	KAZAKHSTAN	OTHERS	TOTAL
Winter Wheat	8.4	6.7	1.0	2.0	18.1
Spring Wheat	16.9	••	15.2	0.2	32.3
Barley	16.1	3.1	6.8	2.9	28.9
Oats	11.0	0.6	0.4	0.6	12.6
Rye	7.3	0.7	0.2	1.4	9.6
Corn	1.1	2.6	0.1	0.7	4.5
Other	7.3	2.2	1.3	0.8	11.6
TOTAL	68.1	15.9	25.0	8.6	117.6

Source: USDA/FAS

The predominant grain crop in the Ukraine is winter wheat, accounting for about 42 percent of harvested area, further the Ukraine accounts for 37 percent of total Soviet winter wheat area. The two other leading grains produced in the Ukraine are barley and corn, which as feedgrains, are used primarily for livestock feeding.

The significance of winter wheat is that this crop is planted in the fall, remains dormant during the winter, emerges in the spring, and is harvested in early summer. The Chernobyl accident occurred when the Ukrainian winter wheat is maturing prior to harvest within the next sixty days. The barley and corn crops would be seeded over this same period for harvest in the fall. Contamination of land may affect this schedule and the quality of the 1986 winter wheat crop.

While average yield data is not available for the Ukraine, this republic almost exclusively consists of Chernozem type soil, or naturally fertile black earth, that is among the most productive in the USSR. As a result, we can assume that under normal conditions, grain yields in the Ukraine are higher than the Soviet average.

The Ukraine accounts for 13.5 percent of total Soviet grain area. Within the Ukraine the three Oblasts most close to the Chernobyl plant (within a 200 km radius) -- Kiyev, Chernigov, Zhitomir--account for about 13 percent of total Ukrainian harvested area. Assuming the Ukrainian yields are half again the Soviet average (estimated by the USDA at 1.61 metric tons per hectare) a loss of the full Ukrainian grain crop would reduce total Soviet grain production by a maximum of about 20 percent. Since not all Oblasts in the republic, notably those in the southeast and extreme southwest, would have received the same amount of radiation contamination, we are assuming that the potential maximum loss to the new Soviet crop would be about 10 percent.

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Using the current USDA estimate of the 1985 Soviet crop of 190 mmt, this would represent a loss of 19 to 20 mmt or a total crop of about 170 mmt. Realistically, the loss is likely to be considerably less.

This outcome would be about the size of the 1984 Soviet crop and would be the third smallest in 12 years. A reduction of this magnitude would not be entirely out of line with extreme weather variations experienced over the past two decades. The major difference might come, however, in a total loss of area due to extreme contamination. Due to the nature of this accident this appears unlikely in all but the land immediately surrounding the plant location. As a result, we do not expect that this will be a major problem for future crops.

Livestock

The Ukraine has the second largest livestock inventories in the USSR, and accounts for 23 percent of total Soviet milk production. The three Ukrainian Oblasts with a 200 km radius of Chernobyl (Kiyev, Chernigov, Zhitomir) account for about 13.5 percent of Ukrainian meat production. Radioactivity will contaminate milk production in virtually all exposed areas. The severity of the contamination will determine whether livestock herds will have to be liquidated. The Soviets have announced that livestock in the immediate vicinity of plant have in fact been slaughtered. The key to keep in mind is that a liquidation of livestock will reduce animal numbers and, consequently, the base of feed demand and grain imports next year. A severe contamination of milk production will likely force the Soviets to import dry milk and dairy products, most likely from the European Community. Traditionally, the Soviets have also increased imports of vegetable oils such as soybean or palm oil to augment a shortfall in animal fat and butter production.

Table 2

Soviet Union
Livestock Numbers by Republic - January 1, 1985
(Million Head)

	Cattle	Cows	Hogs	Poultry	Milk (mil tons)
RSFSR	60.0	22.0	38.7	616.7	50.4
UKRAINE	26.7	9.0	20.9	251.3	22.8
KAZAKHSTAN	9.0	3.2	2.7	52.3	4.6
BYELORUSSIA	7.6	2.7	5.0	44.3	6.6
OTHERS	17.7	6.7	10.6	178.4	13.5
TOTAL	121.0	43.6	77.9	1143.0	97.9

Source: Narodnoe Khozyaistvo. USSR. 1984

Impact on World Food Security

The impact of the Chernobyl disaster is also not likely to have a severe adverse impact on world food supplies. The world is currently faced with record stocks of wheat and coarse grains. According to USDA/FAS data and estimates, global wheat supplies at the end of the current marketing year will total a record 127.7 mmt or almost 25 percent of world demand. This is the largest

stock demand ratio in the past decade. This over-supply condition, largely accounted for by increases in output among importers, have been a major factor behind the recent decline in the total level of world wheat trade.

Similarly, world coarse grain stocks are projected to total a record 162.1 mmt. with the stock demand ratio--the indication of how much demand can be met with stocks--topping out at a two decade record of 20.9 percent.

The point of these statistics is that the world grain markets could absorb a 10 percent decline in Soviet production with relatively little impact on prices or availabilities for other importers.

Supplies of dairy products in the EC intervention stockpiles should be more than adequate to meet increased import demand from the USSR and East European countries affected by the accident. These stockpiles will also help offset any losses experienced by the Scandanavian or other European countries. In fact, the drawdown of these stocks may actually strengthen the EC by reducing costly inventories and boosting a dismal global export outlook.

Last week the Soviets approached the European Community to arrange for the purchase of a wide variety of food items including meat, nonfat dry milk, butter and grains. This is an indication that substantial contamination may have affected food supplies in the area surrounding the Chernobyl plant, or that the Soviets are not willing to take a chance on using available and exposed food and agricultural products. The imports of grains may be used to supplement contaminated fodder for cattle.

The increased exports of these commodities by the EC will be beneficial to the Community through the drawdown of surplus stocks which have become a substantial financial burden for the EC. Additionally, increased agricultural sales to the USSR will help restore the trade balance between the EC and USSR which has titled in favor of the Soviets as a result of EC purchases for natural gas.

It has also been reported that the Soviet Union has approached the U.S. to inquire about purchasing excess dairy cattle that will result from the implementation of the whole-herd buyout program of the 1985 farm bill. The U.S. whole-herd buyout is expected to result in the slaughter of about 1.6 million dairy cows, heifers and calves. Soviet purchases of those animals would prevent additional red meat from entering the U.S. markets and depressing beef and pork prices. This would be a welcome development for U.S. livestock producers who have been under severe financial stress during the past several years.

Impact on East European Agricultural Trade

While the direct impact of the Chernobyl disaster is likely to be relatively small on total Soviet agricultural production, the economies of Eastern Europe will be hard hit by the embargo by the EC and other countries on imports of food and agricultural products from East Europe. The EC has placed a temporary embargo on the importation of fresh and processed meats, live animals, fruits and vegetables and dairy products from all East European countries except the GDR and the Soviet Union.

According to EC statistics, detailed in Table 3, the value of imports by the European Community of these products from Eastern

Europe totaled $713.1 million in 1985. Similar imports from the USSR amounted to only $18.8 million. Poland, Yugoslavia, and Hungary were the largest exporters of food and agricultural products to the EC each accounting for between 25 to 28 percent of total East European agricultural trade with the EC.

Fresh and processed meats, poultry, and fish were the largest East European export category accounting for almost half of the total value of exports followed by vegetables (19 percent) and live animals (17 percent).

Table 3

East European and Soviet Exports of Selected Agricultural Products to the European Community (10) 1985 (Million US$)

	Live Animals	Meat Poultry & Fish	Dairy & Eggs	Vegetables	Fruits	Total
Poland	$30.5	$100.1	$2.0	$34.7	$36.0	$203.3
GDR	9.5	3.7	1.5	.5	.1	15.3
Czechoslavakia	13.2	35.1	5.0	4.4	5.5	63.3
Hungary	24.2	105.2	1.9	29.2	14.4	174.8
Bulgaria	.4	5.8	6.4	5.4	2.9	20.8
Romania	2.2	10.6	1.0	11.7	8.4	33.9
Yugoslavia	41.4	82.9	2.0	47.8	27.9	201.8
TOTAL	$121.2	$343.5	$19.9	$133.5	$95.1	$713.1
USSR	$.1	$13.6	--	$2.6	$2.6	$18.8

Source: COMEXT - EUROSTAT
Note: Totals may not add due to rounding

Exports of food and agricultural products play a major role in the hard currency trade of each East European economy. The Wharton Centrally Planned Economies April 1986 Outlook indicates that exports of food products accounted for 28.6 percent of Hungary's non-socialist hard currency exports in 1985, 15.4 percent of Poland's hard currency exports, and 10 percent of Yugoslavia's exports.

An embargo by the EC or other countries, however, temporary, will hamper the hard currency earnings of each East European country and, as a result, their ability to repay foreign debt. Poland, Yugoslavia, and Hungary are likely to be most severely affected. This is best illustrated in Table 4 which details the year-end 1985 gross hard currency debt of each country and debt service to exports ratios.

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Table 4

CPE Hard Currency Debt Position
(year-end 1985)

	Gross Hard Currency Debt (bill US$)	Debt Service to Exports (ratio)
USSR	$24.8	14%
Poland	30.4	107
GDR	13.6	26
Czechoslavakia	3.0	31
Hungary	10.7	68
Bulgaria	3.2	15
Romania	5.9	26
Yugoslavia	19.0	69

Source: Wharton Econometrics
Centrally Planned Economies Outlook, April 1986

Poland has the largest outstanding currency debt in the region at $30.4 billion followed by Yugoslavia, the GDR and Hungary. When we look at the ability to repay debt on the basis of export earnings, Poland is clearly in the worst situation with a debt service to export ratio of 107 percent. This means that the total of principal and interest on hard currency debt was more than the earnings for total exports in 1985. Hungary and Yugoslavia followed with debt service to export rates of 68 percent and 69 percent respectively.

It must be added that the shorter the embargo, the less severe the impact on the East European economies will be, however some permanent damage to trade is likely to have accrued as a result of consumer fears and attitudes about radioactive contamination of food.

As detailed in Table 5, U.S. imports of food and agricultural products from Eastern Europe are considerably less than EC imports. Poland is the leading exporter to the U.S. accounting for 36 percent of the total value of imports from the region of $260.1 million in 1984. Over 80 percent of Poland's exports to the U.S. are processed meat products.

Table 5

East European Agricultural
Exports to the U.S.
1984 - Million US$

	Processed Meat	Other Products	Total
Poland	$78.1	$16.1	$94.2
GDR	-	1.2	1.2
Czechoslavakia	1.8	8.3	10.1
Hungary	33.8	12.5	46.3
Bulgaria	-	23.0	23.0
Romania	6.3	13.7	20.0
Yugoslavia	30.5	34.8	65.3
TOTAL	$150.5	$109.6	$260.1

Source: USDA/FAS: U.S. Department of Commerce

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While no formal embargo by the U.S. or Canada has been imposed on imports from East Europe, consumer fears about contamination are likely to depress the market for these products considerably.

Impact on United States Agriculture

The U.S. may experience increased Soviet demand for grain and soybean oil as a result of the Chernobyl disaster. Since any major impact on Soviet grain is most likely to be on Ukrainian wheat, the Soviets may be forced to increase wheat imports. This is likely to benefit the European Community (France), Canada, and Argentina more than the United States. Since the USSR is not eligible for price incentives provided by the USDA export enhancement program BICEP, the Soviets in effect pay a premium for U.S. wheat. With more than enough wheat available from our competitors, the Soviets have been buying it elsewhere. This is unlikely to change in the near term.

Wharton Econometrics currently projects the USSR to buy 4.35 mmt (160 million bushels) of wheat during the 1986/87 season. A shortfall of 10 percent in the Soviet harvest may result in as much as an additional 20 mmt of grain imported with the majority accounted for by wheat. If the Soviets increased imports of wheat from the U.S. by an additional 2 mmt (78 million bushels) next season, the U.S. farm price of wheat would increase 14 cents per bushel to $2.64 for the 1986/87 season. Reflecting a loss of area during the next several years for the USSR, we have assumed an additional 1 mmt (36.7 million bushel) increase in Soviet imports over the next three years. this would increase wheat prices annually through 1990.

The USSR has been a major buyer of U.S. coarse grains, primarily corn. Since the Ukraine accounts for again about 13 percent of Soviet corn and barley area, and that the U.S. is the largest supplier of coarse grains, we expect the Soviet coarse grain imports from the U.S. might increase by an additional 5 mmt (197 million bushels) next season, and 2 mmt (79 million bushels) during each of the next three years. Increases of this magnitude over baseline levels of 300 million bushels per year of corn exports would increase U.S. corn prices by 35 cents per bushel during 1986/87 to $2.33. Similarly, increased exports over the next several years would boost prices to $2.32 by 1990, compared with a baseline of $2.05. These outcomes are illustrated in the attached supply and utilization, and tables for the United States.

Conclusion

The Chernobyl nuclear accident is clearly a disaster for the Soviet Union. It is unlikely, however, to result in a larger decline in Soviet grain production than might be expected by recurring adverse weather conditions. The Soviets may find it necessary to increase imports of grain, dairy products, and possibly meat. In the case of increased dairy and meat imports, the most likely beneficiary will be the EC. The Soviets will likely continue to increase wheat imports from non-U.S. sources, but rely on the U.S. for additional coarse grains. Eastern Europe is likely to be more severely affected by the EC embargo on imports of food products.

WHARTON/FAPRI SPRING 1986 LONG TERM BASELINE -- U.S. WHEAT

Variable/Year	84/85	85/86	86/87	87/88	88/89	89/90	90/91
ACREAGE:					(Million Acres)		
Base Acres	93.3	93.3	91.3	91.3	91.3	91.3	91.3
LTCR Acres	0.00	0.00	2.8	8.2	13.7	18.9	24.1
ARP (percent)	20%	20%	23%	28%	30%	25%	20%
Paid Diversion	10%	10%	10%	0%	0%	0%	0%
Partic. Rate		74%	81%	83%	85%	85%	73%
Set Aside Acres	0.0	0.0	23.3	19.0	19.8	15.4	9.7
Planted Area	79.2	75.6	72.1	68.4	62.0	57.9	60.2
Harvested Area	66.9	64.7	64.0	60.9	55.2	51.5	53.6
Yield	38.8	37.5	37.8	38.2	38.7	39.1	39.5
Base Yield	34.7	36.3	37.1	37.1	38.4	38.2	38.3
SUPPLY					(Million Bushels)		
Beg. Stocks	1,399	1,426	1,809	1,985	2,105	1,903	1,487
Production	2,595	2,429	2,422	2,328	2,133	2,013	2,114
Imports	9	12	2	2	2	2	2
TOTAL SUPPLY	4,003	3,864	4,233	4,315	4,240	3,919	3,603
DOMESTIC							
Feed	410	325	381	274	299	306	308
Food	650	660	689	692	699	705	711
Seed, Etc.	93	90	86	78	73	76	82
TOTAL	1,153	1,075	1,156	1,044	1,071	1,087	1,102
EXPORTS							
USSR & PRC	333	147	160	156	165	165	165
PL480 & AID	160	170	165	165	165	165	165
Commercial	931	663	767	844	936	1,015	1,075
TOTAL	1,424	980	1,092	1,165	1,266	1,345	1,405
TOTAL DEMAND	2,577	2,055	2,248	2,209	2,337	2,432	2,506
ENDING STOCKS	1,426	1,809	1,985	2,105	1,903	1,487	1,097
Farmer Held	654	498	440	394	354	300	240
CCC Owned	378	640	753	946	846	625	385
Under Loan	175	520	620	413	309	225	155
"Free" Stocks	219	151	172	352	394	562	472
PRICES:					($/Bushel)		
Farm Price	$3.38	$3.00	$2.50	$2.36	$2.30	$2.37	$2.40
Loan Rate	$3.30	$3.30	$2.40	$2.28	$2.17	$2.18	$2.19
Target Price	$4.38	$4.38	$4.38	$4.38	$4.29	$4.16	$3.95
Reserve Entry	$3.30	$3.30	$2.40	$2.28	$2.17	$2.18	$2.19
Reserve Release	$4.45	$4.45	$4.45	$4.45	$4.45	$4.45	$4.45
Cost per Acre	$70.35	$68.54	$64.95	$67.49	$70.85	$75.32	$81.04
Cost per Bushel	$1.81	$1.83	$1.72	$1.77	$1.83	$1.93	$2.05

CHERNOBYL DISASTER: INCREASED SOVIET IMPORTS -- U.S. WHEAT

Variable/Year	84/85	85/86	86/87	87/88	88/89	89/90	90/91
ACREAGE:					(Million Acres)		
Base Acres	93.3	93.3	91.3	91.3	91.3	91.3	91.3
LTCR Acres	0.00	0.00	2.8	8.2	13.7	18.9	24.1
ARP (percent)	20%	20%	23%	28%	30%	25%	20%
Paid Diversion	10%	10%	10%	0%	0%	0%	0%
Partic. Rate		74%	81%	83%	85%	85%	73%
Set Aside Acres	0.0	0.0	23.3	19.0	19.8	15.4	9.7
Planted Area	79.2	75.6	72.1	68.4	62.0	57.9	60.2
Harvested Area	66.9	64.7	64.0	60.9	55.2	51.5	53.6
Yield	38.8	37.5	37.8	38.2	38.7	39.1	39.5
Base Yield	34.7	36.3	37.1	37.1	38.4	38.2	38.3
SUPPLY					(Million Bushels)		
Beg. Stocks	1,399	1,426	1,809	1,912	1,996	1,759	1,307
Production	2,595	2,429	2,422	2,328	2,133	2,013	2,114
Imports	9	12	2	2	2	2	2
TOTAL SUPPLY	4,003	3,864	4,233	4,242	4,132	3,774	3,423
DOMESTIC							
Feed	410	325	381	274	299	306	308
Food	650	660	689	692	699	705	711
Seed, Etc.	93	90	86	78	73	76	82
TOTAL	1,153	1,075	1,156	1,044	1,071	1,087	1,102
EXPORTS							
USSR & PRC	333	147	233	192	201	201	165
PL480 & AID	160	170	165	165	165	165	165
Commercial	931	663	767	844	936	1,015	1,075
TOTAL	1,424	980	1,165	1,201	1,302	1,381	1,405
TOTAL DEMAND	2,577	2,055	2,321	2,245	2,373	2,468	2,506
ENDING STOCKS	1,426	1,809	1,912	1,996	1,759	1,307	917
Farmer Held	654	498	440	394	325	275	225
CCC Owned	378	640	653	846	746	475	250
Under Loan	175	520	620	413	309	225	155
"Free" Stocks	219	151	199	344	379	557	442
PRICES:					($/Bushel)		
Farm Price	$3.38	$3.00	$2.64	$2.57	$2.48	$2.57	$2.65
Loan Rate	$3.30	$3.30	$2.40	$2.28	$2.17	$2.18	$2.19
Target Price	$4.38	$4.38	$4.38	$4.38	$4.29	$4.16	$3.95
Reserve Entry	$3.30	$3.30	$2.40	$2.28	$2.17	$2.18	$2.19
Reserve Release	$4.45	$4.45	$4.45	$4.45	$4.45	$4.45	$4.45
Cost per Acre	$70.35	$68.54	$64.95	$67.49	$70.85	$75.32	$81.04
Cost per Bushel	$1.81	$1.83	$1.72	$1.77	$1.83	$1.93	$2.05

WHARTON/FAPRI SPRING 1986 LONG TERM BASELINE -- U.S. CORN

Variable/Year	84/85	85/86	86/87	87/88	88/89	89/90	90/91
ACREAGE:					(Million Acres)		
Base Acres	83.3	83.3	83.3	83.3	83.3	83.3	83.3
Set Aside %	10.0%	10.0%	17.5%	20.0%	20.0%	20.0%	20.0%
Diversion %	0.0%	0.0%	2.5%	0.0%	0.0%	0.0%	0.0%
LTCR Acres	0.0	0.0	1.0	2.2	3.3	5.2	7.0
Set Aside Acres	8.3	8.3	12.4	13.0	13.1	12.8	12.5
Diversion Acres	0.0	0.0	2.1	0.0	0.0	0.0	0.0
Partic. Rate	69%	71%	76%	80%	82%	82%	82%
Planted Area	80.5	83.3	75.5	74.5	73.5	72.3	71.0
Harvested Area	71.9	75.1	66.4	65.6	64.7	63.6	62.5
Yield	106.7	118.0	114.0	115.0	116.0	120.2	121.5
Base Yield	102.0	100.2	105.6	105.3	107.0	113.9	106.4
SUPPLY					(Million Bushels)		
Beg. Stocks	723	1,381	3,402	3,570	3,536	3,298	3,048
Production	7,674	8,865	7,572	7,541	7,504	7,647	7,591
Imports	3	2	1	1	1	1	1
TOTAL SUPPLY	8,400	10,248	10,976	11,112	11,042	10,946	10,640
DOMESTIC							
Feed	4,116	4,100	4,492	4,549	4,595	4,577	4,623
Food	858	880	905	923	942	984	1,004
Gasohol	185	220	257	290	319	351	363
Seed	22	20	20	20	19	19	19
TOTAL	5,181	5,220	5,674	5,782	5,875	5,931	6,009
EXPORTS							
USSR	589	275	300	300	300	300	300
PL480 & AID	25	35	35	35	35	35	35
Commercial	1,224	1,315	1,397	1,459	1,534	1,632	1,670
TOTAL	1,838	1,625	1,732	1,794	1,869	1,967	2,005
TOTAL DEMAND	7,019	6,845	7,406	7,576	7,744	7,898	8,014
ENDING STOCKS	1,381	3,402	3,570	3,536	3,298	3,048	2,626
Farmer Held	437	635	623	449	272	260	50
CCC Owned	240	510	1,871	1,805	1,631	1,258	1,120
Under Loan	567	1,850	425	358	370	354	255
"Free" Stocks	137	407	652	924	1,025	1,176	1,201
PRICES:					($/Bu)		
Farm Price	$2.62	$2.37	$1.98	$1.87	$1.82	$1.89	$2.05
Chicago Price	$2.74	$2.57	$2.16	$2.05	$1.99	$2.07	$2.24
Loan Rate	$2.55	$2.55	$1.92	$1.82	$1.73	$1.65	$1.56
Target Price	$3.03	$3.03	$3.03	$3.03	$2.97	$2.88	$2.74
Reserve Entry	$2.55	$2.55	$1.92	$1.82	$1.73	$1.65	$1.56
Reserve Release	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25
Cost per Acre	$160.42	$154.02	$143.13	$147.91	$154.86	$163.78	$175.26
Cost per Bushel	$1.50	$1.31	$1.26	$1.29	$1.33	$1.36	$1.44

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CHERNOBYL DISASTER: INCREASED SOVIET IMPORTS -- U.S. CORN

Variable/Year	84/85	85/86	86/87	87/88	88/89	89/90	90/91
ACREAGE:					(Million Acres)		
Base Acres	83.3	83.3	83.3	83.3	83.3	83.3	83.3
Set Aside %	10.0%	10.0%	17.5%	20.0%	20.0%	20.0%	20.0%
Diversion %	0.0%	0.0%	2.5%	0.0%	0.0%	0.0%	0.0%
LTCR Acres	0.0	0.0	1.0	2.2	3.3	5.2	7.0
Set Aside Acres	8.3	8.3	12.4	13.0	13.1	12.8	12.5
Diversion Acres	0.0	0.0	2.1	0.0	0.0	0.0	0.0
Partic. Rate	69%	71%	76%	80%	82%	82%	82%
Planted Area	80.5	83.3	75.5	74.5	73.5	72.3	71.0
Harvested Area	71.9	75.1	66.4	65.6	64.7	63.6	62.5
Yield	106.7	118.0	114.0	115.0	116.0	120.2	121.5
Base Yield	102.0	100.2	105.6	105.3	107.0	113.9	106.4
SUPPLY					(Million Bushels)		
Beg. Stocks	723	1,381	3,402	3,373	3,260	2,943	2,614
Production	7,674	8,865	7,572	7,541	7,504	7,647	7,591
Imports	3	2	1	1	1	1	1
TOTAL SUPPLY	8,400	10,248	10,976	10,915	10,766	10,591	10,206
DOMESTIC							
Feed	4,116	4,100	4,492	4,549	4,595	4,577	4,623
Food	858	880	905	923	942	984	1,004
Gasohol	185	220	257	290	319	351	363
Seed	22	20	20	20	19	19	19
TOTAL	5,181	5,220	5,674	5,782	5,875	5,931	6,009
EXPORTS							
USSR	589	275	497	379	379	379	300
PL480 & AID	25	35	35	35	35	35	35
Commercial	1,224	1,315	1,397	1,459	1,534	1,632	1,670
TOTAL	1,838	1,625	1,929	1,873	1,948	2,046	2,005
TOTAL DEMAND	7,019	6,845	7,603	7,655	7,823	7,977	8,014
ENDING STOCKS	1,381	3,402	3,373	3,260	2,943	2,614	2,192
Farmer Held	437	635	623	449	272	260	50
CCC Owned	240	510	1,871	1,705	1,331	958	820
Under Loan	567	1,850	425	358	370	354	255
"Free" Stocks	137	407	455	748	970	1,042	1,067
PRICES:					($/Bu)		
Farm Price	$2.62	$2.37	$2.33	$2.19	$1.98	$2.18	$2.32
Chicago Price	$2.74	$2.57	$2.54	$2.38	$2.16	$2.38	$2.52
Loan Rate	$2.55	$2.55	$1.92	$1.82	$1.73	$1.65	$1.56
Target Price	$3.03	$3.03	$3.03	$3.03	$2.97	$2.88	$2.74
Reserve Entry	$2.55	$2.55	$1.92	$1.82	$1.73	$1.65	$1.56
Reserve Release	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25
Cost per Acre	$160.42	$154.02	$143.13	$147.91	$154.86	$163.78	$175.26
Cost per Bushel	$1.50	$1.31	$1.26	$1.29	$1.33	$1.36	$1.44

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WHARTON/FAPRI SPRING 1986 LONG TERM BASELINE -- U.S. SOYBEANS

Variable/Year	84/85	85/86	86/87	87/88	88/89	89/90	90/91
ACREAGE:					(Million Acres)		
LTCR Acres	0	0	1.2	2.5	3.7	5.9	8.14
Planted Area	67.7	63.1	63.0	63.0	65.0	66.0	67.1
Harvested Area	66.1	61.6	62.0	62.0	64.0	65.0	66.1
Yield (Bu/Acre)	28.2	34.1	31.3	31.7	32.1	32.5	32.9
SUPPLY					(Million Bushels)		
Beg. Stocks	176	316	522	504	401	343	257
Production	1,861	2,101	1,941	1,965	2,054	2,113	2,175
TOTAL SUPPLY	2,037	2,417	2,462	2,469	2,455	2,456	2,432
DOMESTIC							
Crush	1,030	1,060	1,119	1,153	1,173	1,186	1,176
Seed & Residual	91	85	90	90	90	90	90
TOTAL	1,121	1,145	1,209	1,243	1,263	1,276	1,266
EXPORTS							
USSR	0	18	4	9	16	22	24
Commercial	598	732	746	816	843	901	907
TOTAL	598	750	750	825	849	923	931
TOTAL DEMAND	1,720	1,895	1,959	2,068	2,112	2,199	2,197
ENDING STOCKS	318	522	504	401	343	257	235
CCC Owned	32	175	150	75	35	0	0
"Free" Stocks	286	347	354	326	308	257	235
PRICES:					($/Bushel)		
Farm Price	$5.85	$5.28	$4.96	$4.85	$4.84	$5.04	$5.44
Chicago Price	$5.88	$5.36	$5.03	$4.91	$4.90	$5.12	$5.54
Loan Rate	$5.02	$5.02	$4.77	$4.77	$4.77	$4.50	$4.50
Bean/Corn Ratio	2.23	2.22	2.51	2.59	2.67	2.66	2.66
Cost per Acre	$76.99	$75.22	$72.27	$74.15	$77.37	$82.08	$88.31
Cost per Bushel	$2.73	$2.21	$2.31	$2.34	$2.41	$2.53	$2.68
Return/Bu.	$3.12	$3.07	$2.65	$2.51	$2.43	$2.52	$2.76
Return/Acre	$87.99	$104.82	$83.06	$79.47	$78.00	$81.81	$90.77

CHERNOBYL DISASTER: INCREASED SOVIET IMPORTS -- U.S. SOYBEANS

Variable/Year	84/85	85/86	86/87	87/88	88/89	89/90	90/91
ACREAGE:					(Million Acres)		
LTCR Acres		0	1.2	2.5	3.7	5.9	8.14
Planted Area	67.7	63.1	63.0	63.0	65.0	66.0	67.1
Harvested Area	66.1	61.6	62.0	62.0	64.0	65.0	66.1
Yield (Bu/Acre)	28.2	34.1	31.3	31.7	32.1	32.5	32.9
SUPPLY					(Million Bushels)		
Beg. Stocks	176	318	522	504	401	343	257
Production	1,861	2,101	1,941	1,965	2,054	2,113	2,175
TOTAL SUPPLY	2,037	2,417	2,462	2,469	2,455	2,456	2,432
DOMESTIC							
Crush	1,030	1,060	1,119	1,153	1,173	1,186	1,176
Seed & Residual	91	85	90	90	90	90	90
TOTAL	1,121	1,145	1,209	1,243	1,263	1,276	1,266
EXPORTS							
USSR	0	18	4	9	16	22	24
Commercial	598	732	746	816	843	901	907
TOTAL	598	750	750	825	849	923	931
TOTAL DEMAND	1,720	1,895	1,959	2,068	2,112	2,199	2,197
ENDING STOCKS	318	522	504	401	343	257	235
CCC Owned	32	175	150	75	35	0	0
"Free" Stocks	286	347	354	326	308	257	235
PRICES:					($/Bushel)		
Farm Price	$5.85	$5.28	$5.28	$5.15	$4.98	$5.31	$5.72
Chicago Price	$5.88	$5.36	$5.36	$5.23	$5.05	$5.40	$5.83
Loan Rate	$5.02	$5.02	$4.77	$4.77	$4.77	$4.50	$4.50
Bean/Corn Ratio	2.23	2.22	2.26	2.35	2.51	2.43	2.46
Cost per Acre	$76.99	$75.22	$72.27	$74.15	$77.37	$82.08	$88.31
Cost per Bushel	$2.73	$2.21	$2.31	$2.34	$2.41	$2.53	$2.68
Return/Bu.	$3.12	$3.07	$2.97	$2.81	$2.57	$2.79	$3.04
Return/Acre	$87.99	$104.82	$92.92	$89.02	$82.35	$90.59	$99.91